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## APPENDICES B - E

Final Report

for

Measuring the Effectiveness  
of the  
Apparel Advanced Manufacturing  
Demonstration Program

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**APPENDIX B:**  
**PRESENTATIONS BY**  
**AMTC STAFF AND RESEARCHERS**

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## **Invited Presentations**

Major invited presentations, some of which included formal papers are listed below.

- April 1988: Dr. Sundaresan Jayaraman  
Swedish Institute for Textile Research  
"Computer Integrated Manufacturing Research in Textiles/Apparel"
- April 1988: Dr. Sundaresan Jayaraman  
Chalmers University of Technology faculty meeting,  
Sweden  
"Research on Textile Structures and CIM in Textiles"
- Sept. 1988: Dr. Sundaresan Jayaraman  
Bobbin Show, CIM Research Committee Conference  
"An Architecture for Apparel Manufacturing:  
Methodology Selection      Criteria"
- February 1989: Dr. Wayne Tincher  
Atlanta Textile Club Meeting  
"Apparel Research at AMTC"
- April 1989: Dr. Sundaresan Jayaraman  
International Conference on Textile Education, Clemson  
"Designing a Textile Curriculum for the 90's"
- May 1989: Gerry Doubleday and Frank Mewborn  
1-day conference at Georgia Tech  
"Improving Profits by Eliminating Guesswork"
- June 1989: Gerry Doubleday  
Total Productivity Involvement Conference, Nashville, TN  
"Improving Profits by Maximizing Productivity"
- August 1989: Dr. Bill Riall  
AMTC UPS Applications Workshop  
"Cost Justification of UPS and Other Advanced Equipment"

- August 1989: Dr. Sundaresan Jayaraman  
International Joint Conference on Artificial Intelligence  
"On a Manufacturing Enterprise Architecture"
- Sept. 1989: Dr. Sundaresan Jayaraman  
Panel member  
International Joint Conference on Artificial Intelligence  
"On a Manufacturing Enterprise Architecture"
- Sept. 1989: Dr. Sundaresan Jayaraman  
Dr. P. Tung  
American Chemical SOciety Annual Conference, Miami  
"On Three Dimensional Multilayer Woven Preforms for Composites"
- October 1989: Dr. Mike Kelly  
Human Factors Society National Conference, Denver  
"Human Factors in Apparel Manufacturing"
- October 1989: Dr. Sundaresan Jayaraman  
Session Chairperson  
NIST Workshop on Apparel Product Data Exchange Standards  
"An Engineering Design Approach to APDES"
- October 1989: Dr. Charlotte Jacobs-Blecha  
Dr. Jane Ammons  
Joint National Conference of the Operations Research Society of America and the Institute of Management Science  
"Cut Order Planning for Flexible Trouser Manufacturing"
- November 1989: Dr. Mat Sikorski  
Fiber Society Conference, Raleigh  
"In-Process Quality Control in Apparel Manufacturing"
- February 1990: Dr. Bill Riall  
2nd International Conference on Manufacturing Technology  
"Economic Justification of Technology Acquisition: New Direction and Evidence from the Apparel Industry"

- April 1990: Dan Ortiz  
Private Rehabilitation Suppliers Annual Conference  
"Research on Human Factors in Apparel Manufacturing"
- April 1990: Dr. Wayne Tincher  
Georgia Tech CIM Center Industry Board Meeting  
"Apparel Manufacturing Research at Georgia Tech"
- April 1990: John Adams  
Georgia Tech Research Center Conference  
"Multi-Unit/Multi-Campus Project Administration"
- April 1990: Dr. Mike Kelly  
Biennial Symposium on Psychology in DoD  
"Human Factors in the Manufacture of Military Uniforms"
- April 1990: Dr. Mike Kelly  
Human Factors Society Conference, Atlanta Chapter  
"Human Factors in the Manufacture of Military Uniforms"
- May 1990: Dan Ortiz  
Ted Courtney  
AMTC Ergonomic Applications Workshop  
"Results of AMTC's Human Factors in Apparel  
Manufacturing"
- May 1990: Dan Ortiz  
International Apparel and Clothing Design Conference  
"Human Factors in Apparel Manufacturing"
- May 1990: Dr. Wayne Tincher  
International Apparel and Clothing Design Conference  
"Apparel Research at AMTC"
- May 1990: Dr. Sundaresan Jayaraman  
The Resurgence of Textile Excellence: A Roadmap for  
Success in the 90's  
"Material Handling: The Key to Global Competitiveness"
- May 1990: Dr. Sundaresan Jayaraman  
First International Symposium on World Class Textile  
Manufacturing  
"Material Handling: The Key to World Class  
Manufacturing"

- June 1990: Dr. Wayne Tincher  
Georgia Tech Minorities Undergrad Research Program  
Meeting  
"Apparel Manufacturing Research at Georgia Tech"
- June 1990: John Adams  
Technology Transfer Society, Dayton, Ohio  
"University Programs Stimulating Technology Transfer"
- June 1990:  
Education  
Dr. Sundaresan Jayaraman  
Annual Conference, American Society for Engineering  
"Designing the Manufacturing Engineer of the Future"
- June 1990:  
Dr. Sundaresan Jayaraman  
Annual Conference, American Society for Engineering  
Education  
"Programming and Software Tools: Need for a  
Synergistic Approach"
- July 1990: Dr. Sundaresan Jayaraman  
International Clothing Conference  
"KES Properties of Difficult-to-sew Fabrics"
- July 1990: Dr. Sundaresan Jayaraman  
International Frontiers in Education 1990 Conference  
"The Challenge of Educating the Engineering Class of  
2000"
- August 1990: Dr. Mike Kelly  
International Conference on Human Aspects of Advanced  
Manufacturing and Hybrid Automation  
"Human Factors in Advanced Apparel Manufacturing"
- October 1990: Dr. Mike Kelly  
National Society for Performance and Instruction, Atlanta  
"Mistakes and Pains"
- October 1990: Dr. Bill Riall  
Technology and Humanities Conference  
"Technology Choice in a Free-Market System"

**APPENDIX C:**

**PUBLISHED ARTICLES BY  
AMTC STAFF AND RESEARCHERS**

## **Published Articles by AMTC Staff Members**

### **AMTC Quarterly**

"Model of the Manufacturing Process"

By: Sundaresan Jayaraman

Status: published August 1988

### **AMTC Quarterly**

"Apparel Manufacturing Architecture: The Function Model"

By: Sundaresan Jayaraman

Status: published May 1989

### **ASTM Standardization News**

By: Bonnie Lann

### **Computer Aided Problem Solving for Scientists and Engineers**

Book published by McGraw-Hill Publishing, New York

By: Sundaresan Jayaraman

Status: to be published in late 1990

### **Human Aspects of Advanced Manufacturing**

"Human Factors in Advanced Apparel Manufacturing"

By: Mike Kelly

Status: published August 1990

### **International Journal of Clothing Science and Technology**

"Discrete Event Simulation of Trouser Manufacturing"

By: Jude Sommerfeld and Wayne Tincher

Status: submitted April 1990

### **Journal of the Textile Institute**

"Designing a Textile Curriculum for the 90's: A Rewarding Challenge"

By: Sundaresan Jayaraman

Status: accepted Sept. 1989

### **Proceedings of the Biennial Symposium on Psychology in DoD**

"Human Factors in the Manufacture of Military Uniforms"

By: Mike Kelly

Status: published April 1990

**Proceedings of the Second International Conference on the Management  
of Technology**

"Economic Justification of Technology Acquisition"

By: Bill Riall

Status: published 1990

**Proceedings of the International Conference on Textile Education  
(refereed)**

"Designing a Textile Curriculum for the 90's: A Rewarding Challenge"

By: Sundaresan Jayaraman

Status: published April 1989

**Proceedings of the American Society for Engineering Education 1990  
Annual Conference**

(refereed)

"Designing the Manufacturing Engineer of the Future: An Educator's  
Perspective"

By: Sundaresan Jayaraman

Status: published June 1990

**Proceedings of the AMerican Society for Engineering Education 1990  
Annual Conference**

(refereed)

"Programming and Software Tools: Need for a Synergistic Approach to  
Computers in Engineering Problem Solving"

By: Sundaresan Jayaraman

Status: published June 1990

**Proceedings of the International Frontiers in Education 1990  
Conferences**

(refereed)

"The Challenge of Educating the Engineering Class of 2000"

By: Sundaresan Jayaraman

Status: published July 1990

**Textile Research Journal (refereed)**

"Design and Development of an Architecture for Computer Integrated  
Manufacturing in the Apparel Industry Part I: Basic Concepts and  
Methodology Selection"

By: Sundaresan Jayaraman and R. Malhotra

Status: published May 1990

**Textile Research Journal (refereed)**

"Design and Development of an Architecture for Computer Integrated Manufacturing in the Apparel Industry Part II: The Function Model"

By: Sundaresan Jayaraman and R. Malhotra

Status: published June 1990

**Textile Research Journal (refereed)**

Vol. 59, no. 4, pp. 237-243

"Weave Room of the Future Part I - Team Approach to Operations: A Simulation Study"

By: Sundaresan Jayaraman and R. Malhotra

Status: published 1989

**Textile Research Journal (refereed)**

Vol. 59, no. 5, pp. 271-274

"Weave Room of the Future Part II - Monitored Data for Real-Time Resource Allocation"

By: Sundaresan Jayaraman and R. Malhotra

Status: published 1989

**Textile World**

"Materials Handling in the Textile Industry"

By: Sundaresan Jayaraman

Status: published Dec. 1989

**APPENDIX D:**

**AMTC QUARTERLY NEWSLETTERS AND TIPS**

**OTHER PUBLISHED ARTICLES ABOUT AMTC**

# AMTC *Tips*

## Evaluating New Technology

Various technological developments in both equipment and methods of production offer the apparel industry opportunities to modernize and gain a competitive edge in the apparel industry. Among them are computer-aided design; computer assistance in virtually all manufacturing areas; new methods for organizing, tracking, and managing production; and opportunities for integrating various aspects of the business. Many of the benefits offered by these opportunities are difficult to quantify. As a result, industry often tends to overlook them. However, when these benefits are ignored, significant current profits and future opportunities may both be lost.

The application of each technology offers a similar set of benefits. However, the characteristics of each technology and differences in applying each technology cause the level of benefits to vary. The list (on the right) of common, but difficult-to-quantify benefits are examples to consider when evaluating equipment purchases. All are important considerations, and many may be critical to making the right choice.

Proper consideration of these benefits demands that information be shared among several facets of the business, particularly production and marketing, and that plans be developed jointly.

Research is currently underway to develop specific approaches to incorporating these benefits into the equipment evaluation process. For more information concerning this research, please contact the AMTC office at (404) 894-3636.

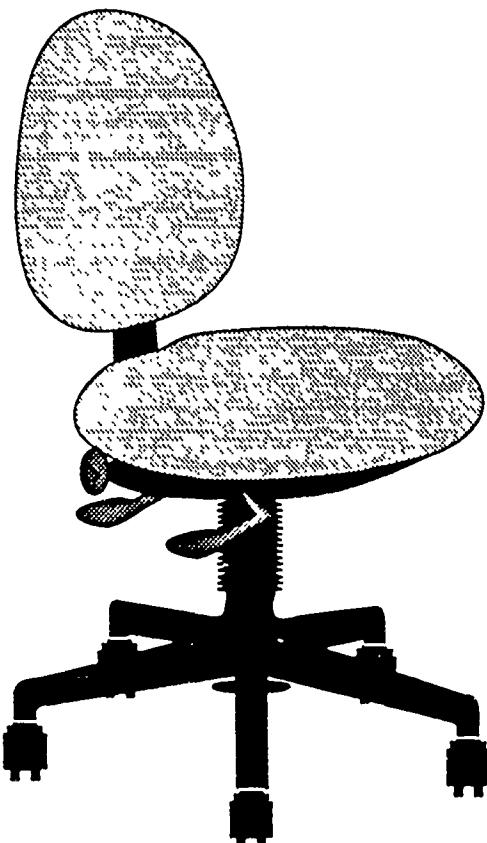
- Experience:** easier upgrading when even newer technologies become available.
- Quality:** fewer rejects, less rework, greater customer satisfaction.
- Integrated Production Functions:** improved line balancing; quicker response to changing product demands; improved management information on quantity, quality, and timeliness.
- Human Factors:** increased safety, lower employee turnover, improved morale, improved productivity, reduced training requirements.
- Precision:** less scrap, increased manufacturing speed and accuracy.
- Plant Layout:** reduced need for future construction, greater flexibility in organizing material flow and equipment placement.
- Material Handling Efficiency:** reduced work-in-process and final goods inventory, reduced throughput times allowing a quicker response to customer needs.
- Adaptability:** to new markets, products, and designs; less manufacturing system obsolescence.

*Dr. William Riall*

*Economic Development Laboratory  
Georgia Institute of Technology*

# AMTC *Tips*

## Chair Design Criteria for Employee Workstations



A well designed chair will help maximize operator productivity while reducing the incidence of lower-back-related health problems. In general, a workstation chair should meet all of the following criteria:

1. The chair should have five legs for structural stability. It should be on casters if the operator stands and sits or frequently moves about at the workstation. If workers must place or obtain materials to or from their side, the chair should swivel to prevent upper body twisting.
2. The height of the chair seat should be adjustable, usually between 15 and 21 inches for sitting tasks. For alternate sit/stand workstations, the chair height should be compatible with the heights of the work surfaces, such that the relationship between the upper body and the two work heights stays the same. Footrests should also be provided. They should have a nonskid surface, be 12 inches to 16 inches long, and slope 30 degrees or less.
3. The backrest should be between 13 inches and 18 inches wide and easily adjustable between 4 inches and 9 inches above the seat cushion. If the backrest is nonadjustable, it should start no higher than 4 inches above the seat cushion, and extend about 18 inches up.

*continued*

Apparel Manufacturing Technology Center Sponsored by the United States Defense Logistics Agency

## People Can Make (or Break) New Technology Systems

**CASE 1:** A large apparel manufacturer had purchased \$250,000 worth of computer-controlled manufacturing equipment to upgrade its operation. But after 15 months, instead of contributing to productivity, the system sat idle in the middle of the plant. Managers were puzzled and disillusioned. Workers were disgruntled. And someone seriously proposed that the firm donate the equipment to a local university because it wasn't working out.

**CASE 2:** A small apparel manufacturer had purchased \$300,000 worth of computer-controlled manufacturing equipment to increase its competitiveness in a tight market. After 9 months, production output was up by 50%, unit costs were down by 40%, and the firm had new contracts because of its shorter response time. The system also helped reduce operator absenteeism and tardiness.

The difference between the two cases above is not just plant size or capacity. Nor is it the compatibility of the system with the operation — both plants had technical problems that had to be ironed out with the vendor. What is different is the approach that was used to implement the new technology. Georgia Tech researchers studied the first case in-depth and compared results with successes such as the second case. Lessons that other plants can learn are as follows:

- Be careful to provide sufficient time and talent to implement the system and get it running to the point that it is accomplishing at least some of the established goals. It will probably take more than you think it should.
- If the new technology represents a radical shift in production methods, treat it as an R&D project until all the operational bugs have been worked out by your people and with your product.
- Many computer-controlled systems require some coordination across departmental boundaries. A high-level manager must ensure that this coordination actually occurs. A staff engineer who must beg the plant manager for support and resources will not be able to implement the system effectively without this "champion" at a higher level.
- Workers unfamiliar with the equipment probably won't be as enthusiastic about the new system as you are. In the early periods of implementation, try to show concern for (1) their problems in learning to use the new equipment, and (2) the constant adjustments they will need to make while management and engineering tinker with the system.
- Involve workers with various aspects of the technological change so that they feel they have some control over the changes.

Dr. Charles K. Parsons  
Georgia Institute of Technology  
College of Management

# AMTC *Tips*

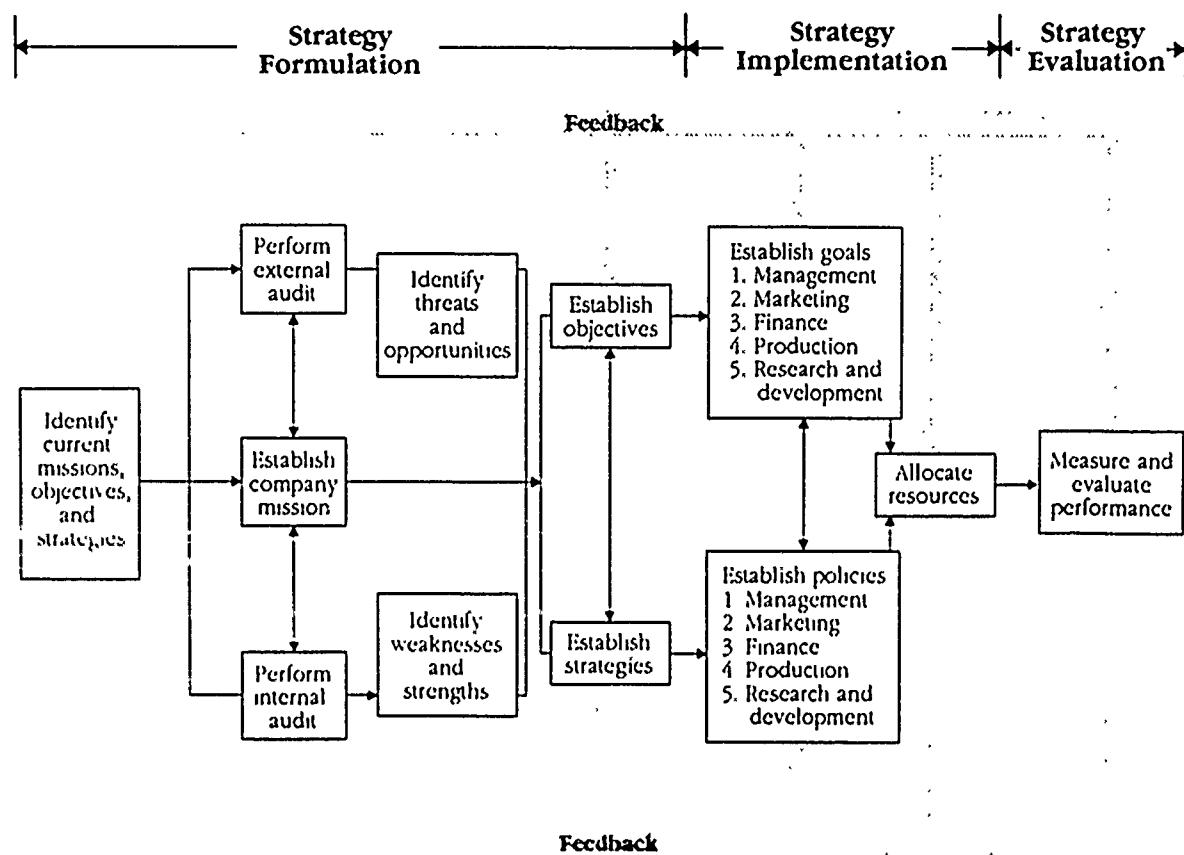
## Strategic Management

Many decisions that managers make are strategic — the effects can be major and have irreversible consequences for the organization. Managers therefore should seek strategies that capitalize on internal strengths, take advantage of external opportunities, temper internal weaknesses, and minimize the impact of external threats.

Strategic management requires research analysis, decision-making, commitment, discipline, and a

willingness to change. The action goals established in the process should concentrate on doing the right things (effectiveness) along with doing things right (efficiency). The organization's success or failure can reflect how fully the strategies were developed.

The strategic management process consists of three stages with feedback loops at each stage: *strategy formulation*, *strategy implementation*, and *strategy evaluation*.



Source: *Fundamentals of Strategic Management*, Fred R. Davis, 1986 Bell & Howell Company

*continued*

# AMTC *Tips*

## Workable for Apparel Flexible Manufacturing Systems

**Q** What is it?

**A** Flexible Manufacturing Systems (FMS) is a manufacturing philosophy in which each work station can process a variety of workpieces with relatively short changeover times. FMS is intended to serve the middle ground of batch manufacturing where the workpiece variety is too low for dedicated processes and too high for stand alone machines.

**Q** Is a high level of automation required?

**A** Not necessarily. The level of automation should be based on the availability of the technology required to meet manufacturing requirements in a cost-effective manner. However, computer integration may be required to allow standard equipment to operate as a unit.

**Q** What are the benefits?

**A** The notion is to apply a set of more general purpose tools to produce a greater range of products. Flexibility can be viewed as a firm's ability to vary what it produces — to adjust operations at any moment to changes in the mix of products the market demands, or to increase productivity through improvements in production processes and product innovation. Other benefits include reduced total throughput time, reduced

level of total inventory (raw materials, work-in-process, and finished goods), and broader style/fabric capabilities.

**Q** What are the requirements for FMS?

**A** Lay and Webb (1988) have described some of the requirements for the apparel industry as follows:

- Smaller lot sizes
- Quality assurance at the source
- Broader operator skill bases, featuring cross-training and the ability to accommodate job changes quickly
- Greater employee involvement in the total manufacturing process
- New forms of employee motivation and compensation, including more emphasis on group effort and total performance rather than individual productivity
- Development of problem prevention methods
- More sophisticated information systems and computer controls of workflow.

**Q** What changes in the apparel industry are needed to take advantage of FMS?

**A** Lay and Webb (1988) suggest the following approaches to making the apparel industry more flexible. First, there must occur an integration of the planning and support systems that surround the manufacturing process with the

*continued*

# AMTC

# Tips

## Save Money By Repairing Air Leaks

Leaks in compressed air lines cost money. Managers at one apparel plant where knit shirts are cut, sewn, and finished found out just how significant these leaks can be. They saved almost \$600 a year by repairing five leaks at a cost of \$50 each. That's a simple payback of less than a year.

Georgia Tech's Energy Resources Group has prepared a table to enable quick calculation of the

power costs associated with compressed air leaks. The apparel plant mentioned above found five leaks, three at 1/8 inch in diameter and two at 1/16 inch. Air compressor discharge was 70 psig (pounds per square inch gage). At a power cost of 5¢ per kilowatt-hour and 2,000 hours of annual operation, the plant was wasting 5,242,000 cubic feet of free air per year at an energy cost of \$587. A sample calculation using the table values are shown below:

$$\text{Power cost} = 3 \text{ leaks} \times \frac{167.80}{\text{leak}} \times \frac{(2,000/2,000)\text{hr}}{\text{yr}} + 2 \text{ leaks} \times \frac{41.80}{\text{leak}} \times \frac{(2,000/2,000)\text{hr}}{\text{yr}} = \$587.00$$

	Hole Diameter [inches]	Free Air Wasted <sup>1</sup> [cubic feet/year]	Cost of Power Wasted <sup>2</sup> [dollars/year]		
			at 4¢/kWh	at 5¢/kWh	at 6¢/kWh
By a leak of air at 70 psig	3/8	13,493,000	\$ 1,210.00	\$ 1,506.80	\$ 1,808.00
	1/4	5,981,000	534.00	670.00	804.00
	1/8	1,498,000	134.00	167.80	201.00
	1/16	374,000	33.50	41.80	50.00
	1/32	94,000	8.40	10.50	12.60
By a leak of air at 100 psig	3/8	18,037,000	\$ 1,995.00	\$ 2,494.00	\$ 3,000.00
	1/4	8,105,000	885.80	1,107.00	1,331.50
	1/8	2,009,000	221.90	276.70	332.90
	1/16	507,000	55.25	69.04	83.00
	1/32	126,000	13.80	17.00	20.70

<sup>1</sup>Based on nozzle coefficient of 0.65.

<sup>2</sup>Based on 18 brake horsepower per 100 cubic feet of free air per minute for 70 psig air and 22 brake horsepower per 100 cubic feet of free air per minute for 100 psig air.

Note: Table shows values for 2,000 hours of operation. To obtain values for different hours of operation, multiply table values by the ratio of actual hours to 2,000 hours.

Hint: Use a soap & water solution to find the exact location of a leak

Adapted from Industrial Energy Extension Service Energy Tip No. 13

Sponsored by the United States Defense Logistics Agency

Apparel Manufacturing Technology Center  
A Unit of the Southern Tech Apparel/Textile Center  
Georgia Institute of Technology  
Southern College of Technology

# AMTC QUARTERLY

Apparel Manufacturing Technology Center  
Sponsored by the United States Defense Logistics Agency

August 88

## AMTC prepares to occupy new building in Marietta

The flurry of construction activity is almost over as our team prepares to install equipment at the new AMTC demonstration site.

Equipment agreements have been signed with Gerber for its creative designer, computerized marker maker and grader, the S95 computer-driven cutter, and the Gerber Mover. Durkopp has agreed to provide machines for sewing darts, button holes, and fly assemblies. Sunbrand, General Services Data (GSD), and Mr. Engineer will provide software packages for our CIM network. Other agreements with companies such as YKK, Juki, and IBM are pending.

AMTC is a "center within a center," an integral part of the new W. Clair Harris Apparel and Textile Center building on the campus of Southern Tech in Marietta, Georgia.

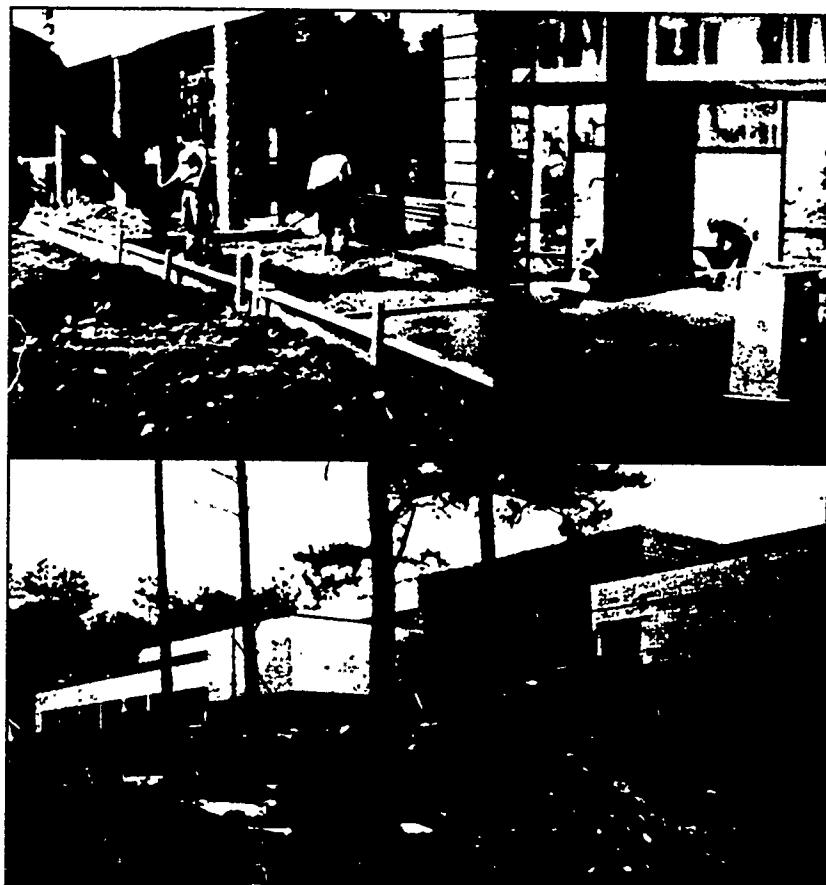
The 20,000-square-foot facility was made possible by funding recommended by the Georgia Board of Regents and received from the research consortium established by Governor Joe Frank Harris. In addition to AMTC, the building will house four classrooms, five high tech laboratories, and an 80-seat lecture hall.

"This is our opportunity to showcase state-of-the-art apparel and textile manufacturing. Our current students will gain valuable hands-on training. That means a lot to industry today," says Larry

Haddock, operations manager with AMTC and head of the Apparel and Textile Engineering Technology Department at Southern Tech. "We also expect to

attract more students to this very exciting but understaffed field."

Current graduates, added Haddock, receive four to six lucrative job offers each.



A ribbon-cutting ceremony will mark the grand opening of the W. Clair Harris Apparel and Textile Center on September 26. AMTC's first demonstration is scheduled for October 24-25.

# AMTC QUARTERLY

Apparel Manufacturing Technology Center  
Sponsored by the United States Defense Logistics Agency

January 89

## AMTC Demonstration a Success

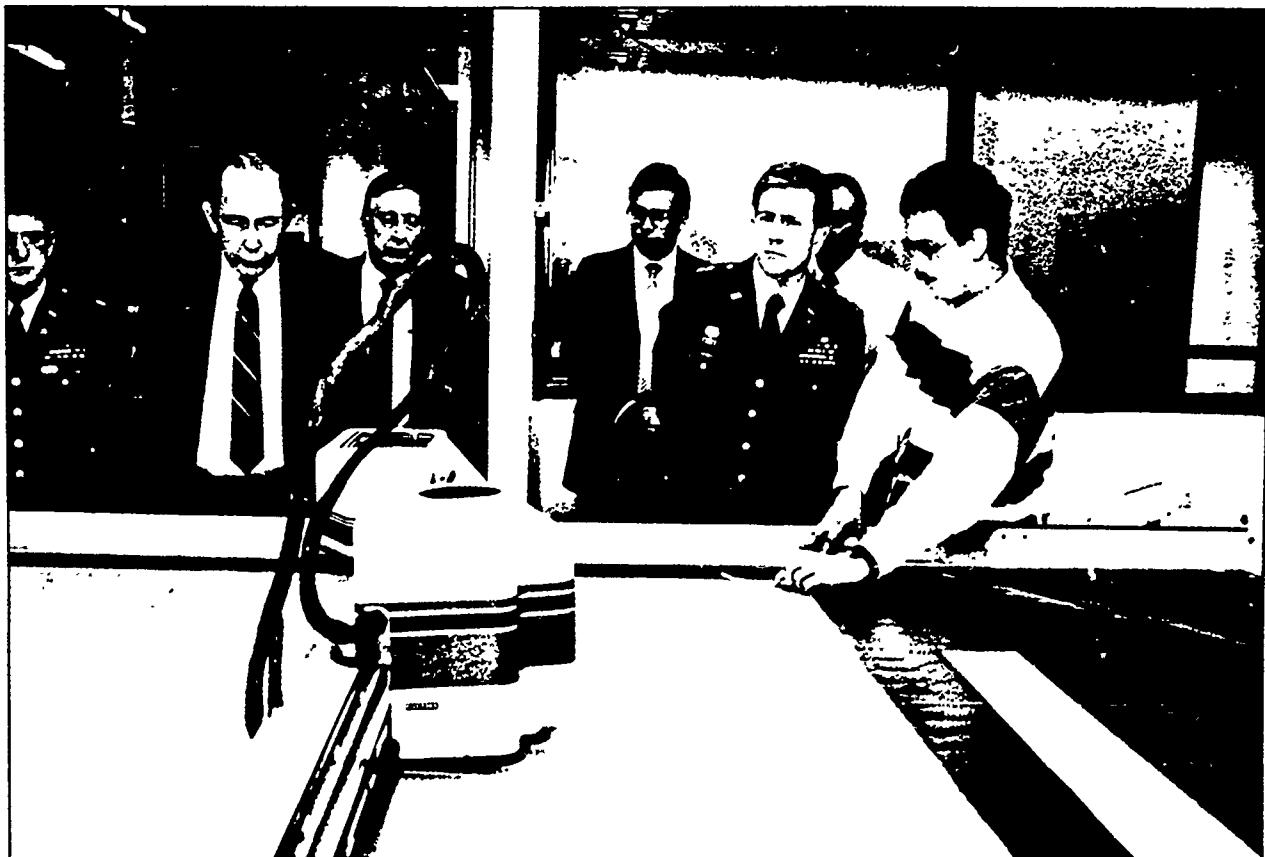


Photo by Gary Meeks

Over 200 manufacturers, suppliers and researchers attended the first major demonstration at the Apparel Manufacturing Technology Center on October 21. The center is located on the Southern Tech campus in

Marietta and is operated jointly by Georgia Tech and the Southern College of Technology under the sponsorship of the U.S. Defense Logistics Agency.

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*A student shows visitors and staff how the Gerber S-95 high-speed cutter automatically spreads then cuts one or two-ply fabric held under vacuum.*

# AMTC QUARTERLY

Apparel Manufacturing Technology Center  
Sponsored by the United States Defense Logistics Agency

May 89

AMTC's first research project, *Design & Development of an Apparel Manufacturing Architecture*, has been underway for over nine months. In this special issue of the *Quarterly*, the project's researchers describe the progress made to date. Six other research endeavors are in progress and will be featured in future issues.

To develop an effective architecture, researchers sought an industry partner to participate in the project. Oxford Slacks of Monroe, Georgia, offered to join forces with AMTC. Through Oxford's support and substantial contributions, the function model was formulated.

Melissa Bailey, Oxford Slacks' Divisional Production Planning Manager, believes that the joint research effort has been rewarding for both parties. According to Ms. Bailey, "The architecture project has been very interesting, and Oxford is pleased to play a role in AMTC's activities."

(CIM) involves the use of computers for the integration of the various operations of an apparel enterprise (see Figure 1):

- Fashion and Product Design
- Marketing and Sales
- Merchandising
- Production Planning
- Materials Requirement Planning (MRP)
- Manufacturing
- Materials Handling
- Quality Control
- Administration
- Financial and Business Management

Here, the terms CIM and CAM are used interchangeably.

An important prerequisite for successfully implementing CIM in the apparel industry is a fundamental study and analysis of the three major facets of the enterprise: function, information, and dynamics [2]. (See IDEF Methodology box for an explanation of the three facets.) Such a definition of the enterprise is known as the architecture.

## Apparel Manufacturing Architecture: The Function Model

by Sundaresan Jayaraman and  
Rajeev Malhotra  
Georgia Institute of Technology  
School of Textile Engineering

### *Introduction*

In its efforts to become more competitive, the textile/apparel industry is concentrating on adopting hi-tech concepts such as Computer-Aided Manufacturing (CAM) [3]. CAM entails the effective utilization of computer technology in the management, control, and operations of the manufacturing facility through direct or indirect computer interface with a company's physical and human resources [1]. Computer-Integrated Manufacturing

## AN ARCHITECTURAL APPROACH TO CIM

The word architecture connotes a coherent and solid structure based on a strong foundation and embodies a goal-oriented design strategy. More specifically, an architecture for apparel manufacturing denotes a framework for the representation and analysis of the enterprise. Because it will serve as a blueprint for implementing CIM in the apparel industry, the architecture should be developed first.

## Editor's Note

Apparel and textile students associated with the AMTC project learn the use of computers and robotics in design, manufacturing and quality control. Intensive classroom and laboratory instruction combined with hands-on experience in the demonstration center, prepare students for quality careers in the textile/apparel industry.

Realizing that much of the student activities and involvement in the research projects conducted at AMTC is

observed only by our staff, we felt it worthwhile to devote a section of the *Quarterly* to the students. While it is not possible to write about each student, it is possible to highlight students which are representative of those contributing to our projects. We will continue to include articles in future issues about student accomplishments in the hope that industry will utilize the Center as a resource for future employees. □

## AMTC Student Profile

A familiar figure in the labs and offices of AMTC is Teresa Bianchi, a graduate technician and administrative assistant who joined the staff in early 1989.

Teresa was hired when Taylar Leigh, AMTC's original graduate technician, left Southern Tech to join the Gerber Garment Technology Center. Prior to leaving, Taylar instructed Teresa on the Gerber Creative Design System, a state-of-the-art unit which includes an imaging screen, scanner, 2D/3D camera and laser printer.

This particular Gerber system allows alterations of a design to be performed totally by the operator. Colors and patterns can be changed by simply entering a command. Designs can be altered by using a stylist pen for adding or deleting features. For example, Teresa can change a long-sleeved casual dress to a sleeveless evening design by "drawing" the desired features on top of the existing one. This capability combined with the scanner and camera allows AMTC visitors to observe immediate changes in garment design. Demonstrating the Gerber Design System to visitors and students alike, is just one of Teresa's many responsibilities at the demonstration center.

A native Atlantan, Teresa is earning a master's degree in Southern Tech's School of Management. She has an undergraduate degree in Clothing and Textiles from Florida State University, and completed the requirements for



Lee Wilder/Ella Street

Southern Tech's Associate degree in Textile Engineering this past year.

Teresa will complete her studies at Southern Tech in 1990 after which she hopes to pursue a career in manufacturing and technical equipment sales. "I believe that the textile apparel industry is a viable field for students today," states Teresa. This is apparent in the educational investment she has made to date and continues to plan for in the future.

AMTC is hopeful more other students like Teresa will be drawn by the advent of advanced technology and management techniques.

# - A - M - T - C -

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Q U A R T E R L Y

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## Modular Group Presentation Experiences "Real-World" Problems



Lee Wilder/Ella Street

Last October, the Apparel Manufacturing Technology Center's pilot plant took on a new product, the camp short, and a new concept, modular manufacturing.

For several months, technicians at the center have studied real-world modular work groups and deliberated on the best implementation scheme for AMTC. The camp short was selected because of its manufacturing simplicity and its compatibility with AMTC's original product, the Navy utility denim trouser. Programmable cutting, bundle sub-assembly, and unit production final assembly are still used to manufacture the trousers. A separate modular area has been established for sub-assembly of the camp short.

The concept was first demonstrated October 11 at AMTC's Modular Manufacturing Workshop. Participants watched a "start-up" modular group experience some common problems of real-world modular manufacturing, such as unbalanced work flow and lack of sufficient operator cross-training.

The modular group ran a total of 12 hours on October 10 and 11. Work flow began to smooth out after eight hours, but constant supervision was required. To increase the group's flexibility, AMTC employed the advanced technology equipment in figure 1.

*continued on page 3*

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*Left: Dale Reichman, a sophomore at Southern Tech, is busy topstitching pocket flaps with the new programmable tacker*

# - A - M - T - C -

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Q U A R T E R L Y

## 50 Years on the Job at Tennessee Apparel

*Florence Harper has spent more than 50 years at Tennessee Apparel. She feels good about the company and the company feels the same about her. This article looks at Florence and some of the things that Tennessee Apparel does to retain loyal employees like Florence.*

Florence Harper believes that being a sewing machine operator is a worthwhile occupation. "If I was 18 today, I'd come here to work — it's still a good job for young people today." And after more than 50 years at Tennessee Apparel in Tullahoma, Tennessee, Florence isn't planning on quitting, either.

Instead, she works four days a week making belt loops because "I like the people." And her fellow employees evidently like Florence, too. Last year at the annual picnic, she was showered with gifts designed to show appreciation of her long-term commitment to the company. Among the items received were 50 red carnations, 50 silver dollars, 50 diet Cokes (her favorite drink), and 50 free meals at her favorite restaurant. All of these were presented under a huge banner that read "Florence Harper Day — 50 Years of Service."

Tennessee Apparel now boasts three plants, more than 500 employees, and equipment that could make other firms envious. Competitors might also envy the apparel company's ability to attract and keep loyal employees. Florence is not the first to put in 50 years of service at Tennessee Apparel. Novella Waller reached that milestone in 1970, and 12 other employees currently have over 30 years of service. And, according to Personnel Manager



*After 50 years, Florence Harper still belts them out. Among her other achievements, she has sewn more than 150 million belt loops.*

Carol Davis, a significant percentage of employees leave only to come back and reapply for their old jobs.

That helps to explain Florence's advice to new workers: "No matter where you go, it won't get any better than here." When asked what makes her stay, Florence explains that satisfying relationships with supervisors and co-workers, good working conditions, Christmas bonuses, attendance awards, and job security are important factors.

Before she underwent open-heart surgery, Florence approached Vice President for Operations Ted Helms about safeguarding her position. Ted replied, "Of course, it wouldn't look right without you here."

According to President John Nicholson, better working conditions and better earnings potential enable this manufacturer of military uniforms to attract and retain a loyal workforce. "One of the things we can sell is that we're running items without a lot of fabric and style changes so it's easier to maintain your earnings," he notes. But more important, when changes are introduced, earnings are protected through guarantees that allow workers time to get up-to-speed on new equipment or new fabrics and styles.

For example, when the company purchased a Gerber cutter, management was not sure it would be an improvement for quite a while. In fact, management was willing to risk some financial losses for a limited time before the machine actually paid for itself in increased productivity. Greater precision in cutting, of course, can increase the productivity of sewing machine operators by reducing rework.

"You have to sell employees on new equipment before it's even installed," Nicholson explains. "We install new equipment on a trial basis

*continued on page 5*

# GEORGIA TECH RESEARCH

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## News Release

Research Communications Office  
Georgia Institute of Technology  
Atlanta, Georgia 30332  
(404) 894-3444

CONTACT: Connie Cummings (404) 894-2452  
or Mark Hodges (404) 894-6987

GEORGIA TECH TO MANAGE APPAREL  
ADVANCED MANUFACTURING CENTER

For Immediate Release  
September 28, 1987

ATLANTA, GA -- The U.S. Defense Logistics Agency has awarded Georgia Tech a three-year contract, valued at more than \$5 million, to manage a center for developing and demonstrating new technologies in automated apparel manufacturing.

Tech will develop one of three Apparel Advanced Manufacturing Technology Demonstration Centers sponsored by the Defense Logistics Agency. The other two are being initiated at Clemson University and the Fashion Institute of Technology in New York. The Tech center will become operational in spring, 1988, says program manager John Adams of Tech's Economic Development Laboratory.

Tech will work with processes for manufacturing four types of military shirts first, and deal with civilian shirts and military trousers later.

Much of the Tech center's research will take place at a 5,000-square-foot demonstration plant located on the Southern College of Technology campus in Marietta. Industry will loan or donate the necessary equipment for the plant.

Dr. Wayne Tincher, a professor of textile engineering at Georgia Tech, will head the center's research and development program, while Dr. Larry Haddock, director of Southern Tech's Apparel/Textile School, will be in charge of the demonstration plant's operations.

"The primary goal of the center is to assist apparel manufacturers in evaluating advanced manufacturing technology to improve their productivity," Adams says. "The

federal government wants domestic apparel suppliers to reduce costs of delivering military apparel. It also sees the need to strengthen the domestic industry so that it can start regaining markets lost to foreign competitors."

Adams says that a secondary objective of the center is to demonstrate the application of non-traditional capital investment criteria to support investment in advanced apparel manufacturing systems and equipment.

In addition to researching and demonstrating automated shirt-making technologies, the center will operate an Apparel Manufacturing Information Service to disseminate data to the industry. More detailed information will be available to members of a coalition of apparel firms and relevant industry organizations that will be formed to support the center.

The government's support of the center will run for a minimum of three years, with a two-year option period. Adams expects the center to generate enough coalition members for it to become self-perpetuating after the initial three-year seed grant expires.

#####

# Georgia Tech

News Bureau

September 25, 1987

**Georgia Institute of Technology**  
Communications and Development  
Atlanta, Georgia 30332-0181  
404-894-2452

Dear Colleague:

The Research Communications Office and the News Bureau would like to invite you to be our guest at an informal luncheon at noon, Friday, October 2 to talk with the managers of a new advanced technology apparel research center.

Here's the low-down:

The need for developing more cost effective methods to manufacture clothing within the United States, to better compete with foreign manufacturers, has prompted the U.S. Defense Logistics Agency to take action. The agency has funded three centers which will test new automated apparel manufacturing techniques. One of them will be managed by Georgia Tech. (Please see enclosed news release.)

The immediate aim is to come up with technologies that will allow American apparel manufacturers to produce military clothing more cheaply. The long-term aim is to apply those technology and management improvements in the apparel manufacturing industry on a broader scale so that American companies can better compete with foreign clothing manufacturers.

The Research Communications Office and the News Bureau have arranged for the principals involved with directing the Georgia Tech Apparel Advanced Manufacturing Technology Demonstration Center to be available to interested reporters and editors during an informal lunch Friday, October 2 from noon to 1:30 p.m. Please join us in room 403 of the Centennial Research Building on the Tech campus. (At the corner of 10th Street and Dalney Street. Parking available at second gate parking lot beyond CRB on Dalney Street by buzzing security guard.)

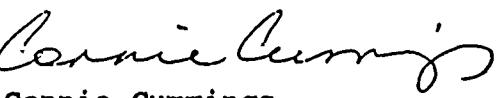
Who will be there?

John Adams, program manager; Dr. Wayne Tincher, the center's research and development director; and Dr. Larry Haddock, the center's plant operations manager.

Please let us know if you (or someone from your organization) can come by calling the News Bureau at (404) 894-2452.

Sincerely,

  
Mark Hodges  
Assistant Director,  
Research Communications Office

  
Connie Cummings  
Associate Director,  
News Bureau

BIA-60 AMERICAN DYESTUFF  
REPORTER  
MONTHLY 13000

NOVEMBER 1987

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**Georgia Tech  
Apparel Contract**

The U.S. Defense Logistics Agency has awarded Georgia Tech, Atlanta, GA, with a three-year contract, valued at more than \$5 million, to manage a center for developing and demonstrating new technologies in automated apparel manufacturing.

Tech will develop one of three Apparel Advanced Manufacturing Technology Demonstration Centers sponsored by the Defense Logistics Agency. The other two are being initiated at Clemson University and the Fashion Institute of Technology in New York City. The Tech center will become operational in spring, 1988, says program manager John Adams of Tech's Economic Development Laboratory.

Tech will work initially with processes for manufacturing four types of military shirts first, and deal with civilian shirts and military trousers later.

Much of the center's research will take place at a 5,000-square-foot demonstration plant located on the Southern College of Technology campus in Marietta. Industry will loan or donate the necessary equipment for the plant.

Dr. Wayne Tincher, a professor of textile engineering at Georgia Tech, will head the center's research and development program, while Dr. Larry Haddock, director of Southern Tech's Apparel/Textile School, will be in charge of the demonstration plant's operations.

*[Handwritten Signature]*  
Client

Columbus Ledger/Enquirer

Name of Georgia Newspaper

OCT 03 1987

Date

## Georgia Tech's Goal: Automate Clothes-Making

By Clint Williams  
Atlanta Bureau

ATLANTA — Making America's apparel manufacturing industry more productive and competitive is the goal of a three-year Georgia Tech research project.

The U.S. Defense Logistics Agency awarded Georgia Tech a three-year, \$5 million contract to manage a center for developing improvements in automated apparel manufacturing. A demonstration plant will be located at Southern College of Technology in Marietta in the spring of 1988. More than 13 machinery manufacturers have expressed interest in providing equipment, said John Adams, program manager.

"We will establish an existing state-of-the-art facility," said Wayne Tincher, a Tech textile engineering professor who will head the center's research and development program.

The center will study ways to best use existing equipment and "research new systems to advance the state of the art," Tincher said. "We think there has to be more flexible automation."

Automation now does just one of the 30 to 40 steps in making a shirt, said Larry Haddock, director of Southern Tech's Apparel/Textile School.

The primary goal of the project is to make it easier and cheaper for domestic companies to make military uniforms. The federal Defense Logistics Agency is "concerned about the American apparel industry's ability to respond to an emergency."

## News

December 4 and lunch the following day. Pre-registration fees are \$45 for members and \$20 for spouses. On-site registration is \$55 for members and \$25 for spouses. Students can attend the meeting at no charge.

Pre-registration should be completed by November 27 and payment sent to Phil Frazier, AATCC, 2401 Oberbeck Lane, Charlotte, N.C. 28210. Overnight accom-

modations should be made direct with the Sheraton Century Center Hotel, 2000 Century Boulevard NE, Atlanta, Ga. 30345; telephone 404/325-0000.

### Georgia Tech Selected For Apparel Manufacturing Center

The U.S. Defense Logistics Agency has chosen Georgia Tech to operate one of three apparel demonstration facilities funded by the agency. The school, which was awarded a three-year contract valued

at more than \$5 million, will manage a center for developing and demonstrating new technologies in automated apparel manufacturing facilities. Similar demonstration facilities will be established at Clemson University and the Fashion Institute of Technology in New York.

"The primary goal of the center is to assist apparel manufacturers in evaluating advanced manufacturing technology to improve their productivity," said John Adams, program manager for the Georgia Tech facility. "The federal government wants domestic suppliers to reduce costs of delivering military apparel."

The school will initially work with processes for manufacturing four types of military shirts, and later focus on civilian shirts and military trousers. Much of the center's research will take place at a demonstration plant on the Southern College of Technology campus in Marietta, Ga. Industry will loan or donate the necessary equipment.

### Rhone-Poulenc Buys Stauffer Business From ICI Americas

ICI Americas has sold the basic chemicals businesses of Stauffer Chemical Co. to Rhone-Poulenc for \$522 million. The businesses manufacture inorganic commodity chemicals for sulphuric acid and sulphur based products, phosphorus products and soda ash.

ICI purchased Stauffer for \$1.69 billion in July, primarily for the Stauffer agricultural business. According to ICI, the acquisition improved the company's position from eleventh to fourth in the U.S. agrochemicals market and from sixth to third in the world agrochemicals market.

The agreement with Rhone-Poulenc is the second disposal of Stauffer businesses by ICI. In August, the Stauffer specialty chemicals business was sold to Akzo, a subsidiary of Akzo Chemie America, for \$625 million. ICI also plans to sell three smaller businesses in the formulated foods, fabricated plastic products and chloralkali areas.

### Ciba-Geigy Realigns Pigments Department

The pigments department of Ciba-Geigy Corp. has reorganized into the automotive and industrial finishes business center and the plastics, fibers and inks business center. The changes are the result of several recent developments including the completion of Quinacridone pigment finishing facilities in Newport, Del.; increased manufacturing capacity at Drakenfeld Colors in Washington, Pa.; the introduction of Unisperse and Microlith pigment preparations and Daihan Swiss pigments; and the development of an organic red pigment for automotive finishes.

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## **Georgia Tech to Manage Apparel Advanced Manufacturing Center**

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Much of the Tech center's research will take place at a 5,000 square foot demonstration plant located on the Southern College of Technology campus in Marietta, Ga. Industry will loan or donate the necessary equipment for the plant.

The Tech center will become operational next spring, according to program manager John Adams of the Economic Development Laboratory.

**52 FALL 1987**

Dr. Wayne Tincher, a professor of textile engineering, will head the center's research and development program, while Dr. Larry Haddock, director of Southern Tech's Apparel/Textile School, will be in charge of the demonstration plant's operations.

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The government's support for the center will run for a minimum of three years, with a two-year option period.

affected by the adaptation of genetic research to crop production will include fruits, vegetables and grain.

#### Pulsing Light

PASADENA, Calif. — Researchers at the California Institute of Technology have demonstrated an instrument using pulses of light one millionth of a billionth of a second in duration to detect sequences of events in high-speed chemical reactions. The instrument was described by Ahmed H. Zewail, the research group's head, as capable of recording the stages of chemical bonding.

#### Materials Research

ALBANY, N.Y. — A study aimed to establish advanced materials technology centers throughout New York has been completed for the New York State Science and Technology Foundation by Battelle Memorial Institute, Columbus, Ohio. Two of the centers have been designated at Alfred University and Clarkson University.

#### Die-Cast R&D Center

BEDFORD, Ind. — Two General Motors Corp. divisions, Central Foundry of Saginaw, Mich., and Hydra-matic of Ypsilanti, Mich., will team up to build an R&D center to research die-cast technology.

#### DOD Initiative

## Apparel Tech Centers Boost Automation

By Michael Watt

ALEXANDRIA, Va. — Industry observers have high hopes for the apparel manufacturing technology centers that are being set up under a multi-million dollar Defense Department initiative.

The Defense Logistics Agency last fall disclosed a program to spend at least \$13 million that would encourage manufacturers to install machinery needed to meet military requirements. The program hopes to increase apparel manufacturers' awareness and usage of available technology.

Peter Lanzer, vice president of sales for Gerber Garment Technology Inc., Tolland, Ct., said the time is right for these centers to be established. "The American apparel industry lags behind the European industry in the application of production technology and more manufacturers at this moment seem ready and willing to bring production back from the Far East."

Lanzer added that the apparel manufacturers, "have seen the light of having to mod-

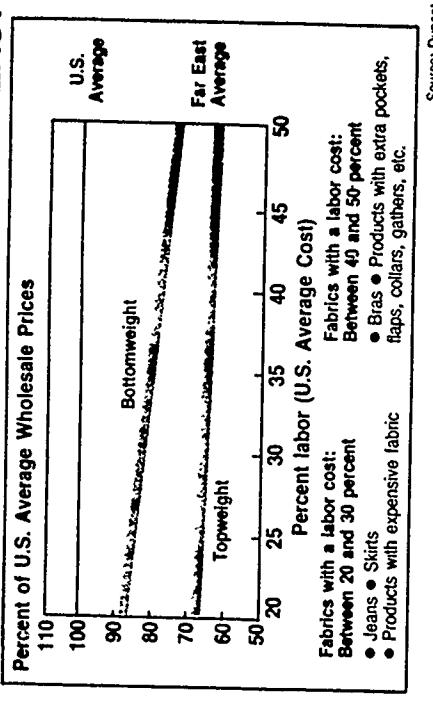
ernize the industry. The whole quick-response technology push is really beginning to take hold of American apparel manufacturing."

The Advanced Apparel Manufacturing Centers at the Georgia Institute of Technology, Atlanta; Fashion Institute of Technology, New York; and Clemson University, Clemson, S.C.; are expected to be opened by next fall. Each school was awarded a three-year contract—with an option for two more years at DLA's discretion—that is worth between \$3 million and \$10 million.

Don O'Brien, chief of the production management support office here, said the DLA hopes that the centers will create an environment where apparel manufacturers can learn about technology from experts familiar with the problems of apparel manufacturing.

He added that the DLA also believes that helping the industry's competitive position worldwide makes for a stronger, more competitive industry at home and should bring down the cost of military apparel. Brooks Brothers, a member

#### APPAREL RETAILERS' SOURCING COST UNITED STATES VERSUS THE FAR EAST



This chart shows how the labor-intensity of a fabric favors Far East manufacturers with their lower labor costs.

sonnel and manufacture test batches of apparel.

FIT's center will demonstrate how to make tailored clothing, including suit coats, pants and overcoats, Clemson will be making shirts and Georgia Tech will be make military and civilian shirts and pants.

The schools also plan to create an Apparel Manufacturing Information Service to provide information concerning the practical application of advanced technology products and systems.

The schools are required to form coalitions of apparel and textile manufacturers, equipment suppliers and other manufacturers.

1A-180 ADVANCED  
MANUFACTURING TECHNOLOGY  
SEMI-MONTHLY

DECEMBER 21, 1987

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AUTOMATED APPAREL  
MANUFACTURING R&D

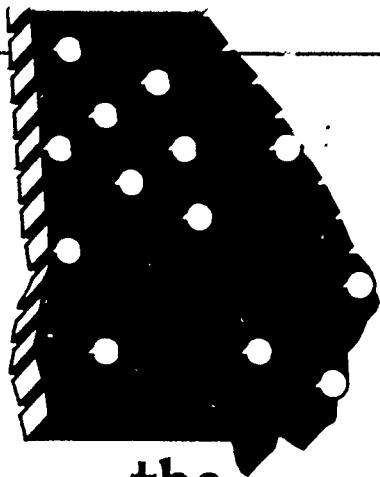
Three demonstration centers for advanced manufacturing technologies for apparel will be established at Georgia Tech (Atlanta), Clemson University (Clemson, SC), and the Fashion Institute of Technology (New York). Centers are sponsored by U.S. Defense Logistics Agency to encourage automation of military uniform manufacturing.....

.....At Georgia Tech a three-year contract, valued at more than \$5 million, is seed money. Industry, in the form of industry coalition members, is expected to take up support at end of three years, although Defense has the option of renewing its support for another two years.....

.....Tech will work with processes for manufacturing four types of military shirts first, then deal with civilian shirts and military trousers. Primary goal will be to assist manufacturers in evaluating technologies to improve their productivity. Secondary objective is to demonstrate nontraditional capital investment criteria to support investment in advance manufacturing systems. Center will be operational next spring with Dr. Wayne Tincher heading R&D and Dr. Larry Haddock heading demonstration plant.....

.....Details: John Adams, Program Manager, Economic Development Laboratory, Georgia Institute of Technology, Atlanta, GA 30332. Phone: 404-894-4138.

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Atlanta, GA. 30332  
(404) 894-3830

## PARTICIPATIVE MANAGEMENT: HOW YOU CAN MAKE IT WORK

**W**hen used well, participative management has great potential to increase efficiency and performance for businesses of all sizes.

But what is participative management? It is a commitment on the part of top management to tap all employees' experience and ideas in order to improve the company. Different techniques are aimed at increasing participation in setting goals, making decisions, solving problems, and implementing changes.

The benefits of participative management are as diverse as the techniques. Substantial research evidence shows that companies can increase productivity, reduce operating costs, increase job satisfaction (thereby reducing turnover), become more efficient, and increase performance with participative management. A more involved work force can help your company adapt to changing conditions quickly—an important competitive edge.

Despite the potential advantages, not all attempts are successful. Many companies have embarked on stylish "programs" only to produce costly failures. How can you make it work?

Some keys to success are:

- **Commitment.** Participative management isn't a project that can be completed and forgotten. It's a continuing commitment to improvement that must be shared at all levels of the company. Let your people know that you are committed to this, and that their input is essential. You can't expect your employees to be committed unless you are.
- **Feedback.** Encourage workers to continue contributing by responding to every idea. If one can't be used, explain why. And be sure to reward useful ideas and changes.
- **Planning.** Before adopting participative management, a company should assess its current management style and plan how to strategically move towards participative management. Remember—everyone will be involved in the changes and should know what the plans are.

GTRI's Industrial Extension Division can help you learn more about participative management, assess your company's readiness, and help implement the strategy that will work for you.

help manufacturers get government contracts, and better train graduates entering the industry.

The goal of the Center, which was contracted by the U.S. Defense Logistics Agency and involves industry support, is to combat foreign competition by helping America's ap-

## CENTER TO AID APPAREL INDUSTRY

**G**eorgia Tech's Economic Development Laboratory, along with Tech's School of Textile Engineering and the Southern College of Technology, has initiated a \$5 million program to help apparel manufacturers improve productivity and broaden their markets.

The Apparel Manufacturing Technology Center will demonstrate new manufacturing technology for military and civilian clothing, conduct research to improve equipment and plant productivity, train personnel in advanced manufacturing equipment,

**AMTC**

parel industry use new technology to reduce costs and production response time. The Center's demonstration plant on the Southern College of Technology campus will begin operation this fall.

# CASE STUDY

## RAPID GROWTH PUSHES FIRM TO NEW STRATEGIES

Owners of a small Georgia business engaged in the manufacture of jam and jelly products had experienced a ten-fold growth in sales during the past 18 months. Consumer demand for their high-quality products had frequently outstripped supply, and the company was forced to move into larger manufacturing facilities.

Growth, however, was not without hardship. Due to the lack of experience in managing a "manufacturing" concern, company owners found themselves faced with several growth-related problems. Raw materials costs were escalating dramatically, inventory levels became unstable as production runs fluctuated, and overhead costs soared. The company realized it needed new strategies to cope with the high demand for its products.

The owners called on Georgia Tech to assist them with developing accurate estimates of product costs, analyzing the current financial picture, gaining control over raw material inventory and finished goods, and planning future growth strategies.

Under the Economic Development Administration's University Center program, engineers from Georgia Tech were able to address each of these areas and make recommendations to improve overall manufacturing operations at the company.

### NEEDS ANALYSIS

During the needs assessment phase, Georgia Tech engineers held roundtable discussions with company managers to learn about current operations. It became quite clear that insufficient financial and manufacturing planning were the prime causes of concern.

Although company managers had "hoped" for sales to increase, they had not "planned" for the increase to happen, and consequently, had been unable to respond to the challenge effectively.

### BUSINESS PLAN DEVELOPMENT

Based on financial statements prepared by the company's accountant, Georgia Tech engineers found that costs were exceeding revenues and that company assets were not being utilized effectively. This set the stage for developing workable manufacturing plans for the company to use in planning its growth strategy.

Using a microcomputer and a spreadsheet program, Georgia Tech engineers and company management began to develop a master database of all raw material items and finished goods. For each finished good, they developed bills of material on a per-jar basis. They also estimated per-jar costs for raw materials, labor, and overhead. By comparing these to current selling prices, they were able to determine profitability margins.

A 12-month sales projection of

each product enhanced management's ability to regularly "plan" for manufacturing products. Managers now have estimated revenue forecasts by product line and raw material usage levels for the coming year, so they can develop realistic estimates of material order quantities, lead times, and safety stock levels.

### RESULTS

Armed with this information, company managers can now talk to vendors about purchasing materials in large quantities on a specific delivery schedule. They can also set up realistic annual budgets for manufacturing, sales, and marketing. And by comparing current revenues, expenses, and product costs to established standards, they can project labor, material, and capital resource needs of the business as it continues to grow.

### PRODUCT COST ESTIMATE

A	B	C	D	E	F	G	H	
1	Product Cost Estimate							
2	Product Number: 101		Product Description: Jelly Small Jar					
3								
4	LINE ITEM	P/N	Qty	Item Description	U/M	U/QTY	Unit Price (\$)	Extension (\$)
5	1	620	1	Jar 8 oz. Size	EA	1.00	\$0 1782	\$0.1782
6	2	624	1	Label	EA	1.00	\$0 0232	\$0.0232
7	3	630	1	Lid for 8 oz Jar	EA	1.00	\$0 0560	\$0.0560
8	4	633	0 6667	Juice	CUP	1.00	\$0 2841	\$0 1894
9	5	642	0.2386	Sugar	LB	1.00	\$0 3140	\$0.0749
10	6	643	0.1777	Surjell	BOX	1.00	\$0.9363	\$0 1664
11	7	644	1	Tie Card	EA	1.00	\$0.0134	\$0 0134
12	8	645	1	Tie Cord	EA	1.00	\$0.0158	\$0 0158
13	9	648	1	Topper for 8 oz Jar	EA	1.00	\$0 0109	\$0 0109
14								
15								TOTAL EXTENDED MATERIAL COST (\$)
								\$0 7282

Using a spreadsheet system set up by Georgia Tech engineers, the company can now calculate the cost of each product on a microcomputer. In addition to the material costs (calculated as part of the Product Cost Estimate, above), other linked spreadsheets detail labor, overhead, and commissions costs to obtain total costs for each jar. With the cost sheet and the Master Production Schedule (top right), sales for each month can be forecast (Master Sales Schedule, middle right). Raw materials requirements (Master Raw Materials Schedule, bottom right) are calculated, allowing the company to plan bulk purchases and materials delivery schedules.

Before, this was difficult because all calculation was done manually. With the spreadsheet system, any variable can be easily changed with all totals automatically recalculated, a definite plus in coping with a changing future.

### MASTER PRODUCTION SCHEDULE

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1	Master Production Schedule			
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AUGUST 8, 1988

CLIPPED BY Bacon's

## HIGH-TECH CENTERS READY TO STRUT THEIR STUFF

By HOLLY HABER

NEW YORK — After almost a year of gathering sophisticated equipment for apparel manufacturing, three centers of advanced technology are preparing their demonstration facilities to open to the industry this fall.

The centers — at the Fashion Institute of Technology, here; Clemson University, Clemson, S.C., and Southern Tech, Marietta, Ga. — were chartered last year by the Defense Logistics Agency, the arm of the Defense Department that buys uniforms and other supplies.

Concerned about the ability of the nation's shrinking textile and apparel manufacturing base to support the military's needs, DLA allotted up to \$12 million over three years to establish these high-tech hubs as teaching and demonstration facilities. They are intended to serve manufacturers of civilian as well as military clothes. The universities and private companies are providing additional financial and professional support. Equipment suppliers are loaning machinery to get the projects under way.

Each center is assembling an automated production line for one type of garment. FIT is focusing on men's tailored pants, Clemson is concentrating on shirts and Georgia Tech is attending to denim pants.

The facilities have received mixed responses from the industry in the nine months they've been procuring machinery and trying to stir enthusiasm among apparel manufacturers. FIT said interest has been minimal, but Georgia Tech and Clemson said support in their areas has been strong.

"Manufacturers are not exactly breaking the door down, but we are holding some meet-

So far, Seesselberg has rounded up an Eton unit production system, a Gerber cutter, automatic surging machines and other electronic sewing equipment.

The other two centers said they've had staunch support from the industry.

Clemson Apparel Research has about 35 firms working to fine tune the center, scheduled to open Nov. 4 in Pendleton, S.C.

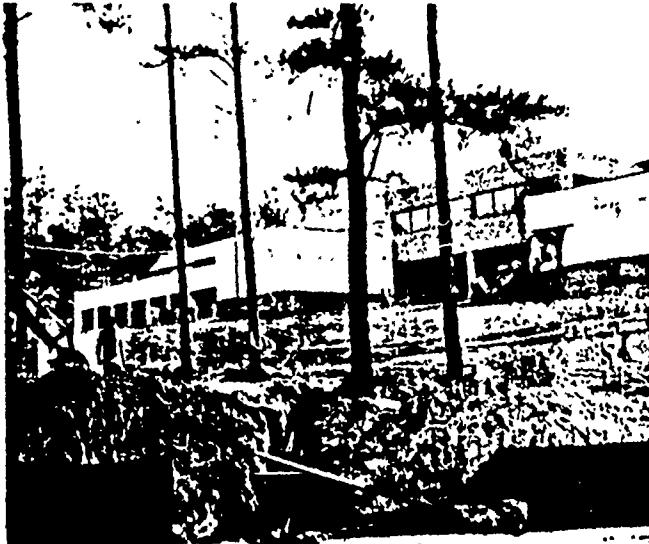
"Members of the steering committee all along have been very enthusiastic and now they are starting to get antsy because they want to see all these toys," said Dr. Christine Jarvis, a textiles professor who is the principal administrator of the project.

Executives from Gilbert Associates, Greenwood Mills Marketing, Hampton Industries, Iva Manufacturing, Milliken & Co., Oxford Industries, Stone Manufacturing Co., Tanner Manufacturing and Grumman Data Systems are members of the steering committee at Clemson Apparel Research.

"The interest is from people who have never handled a government contract and probably never will," Jarvis pointed out. "But they are interested in the technology." Besides compiling manufacturing machinery, Clemson hopes to receive Department of Defense funding to develop a computer program for detailed cost-analysis and to work on robotics.

Clemson expects to start receiving equipment today to set up a complete production line for shirts. Machinery on loan to the center will include Microdynamics products for design, pattern grading and marking, as well as a number of automated sewing machines.

Southern Tech plans to dedicate the W. Clair Harris Center of Apparel and Textile Ex-



Construction is almost finished of the W. Clair Harris Center of Excellence in Apparel and Textile Manufacturing

ings to decide what will appeal to them," said Henry Seesselberg, director of operations at FIT's Advanced Apparel Manufacturing Technology program. "We want to see what they want us to demonstrate and what will help them make decisions about what to buy."

Seesselberg, a former Singer Sewing Co. engineer, said American apparel manufacturers seem reluctant to automate. "We're not using the technology that is available in this country," he said. "Many foreign equipment suppliers choose not to market in this country because of our history of not spending money on capital equipment."

But he hopes to stimulate interest once the center opens in November in the basement of FIT's main building. "We believe that once they see it running they will ask us to try things or to use the equipment," he said. Companies that have participated in establishing the FIT facility include Hartmarx, Van Heusen and Cavalier Clothes.

cellence Sept. 26, with the first demonstration planned for Oct. 24 to 26.

"I've been very encouraged by the response," said John Adams, the director of the center and senior research engineer at the Georgia Institute of Technology, Atlanta, which is working closely with Southern Tech to establish the facility. "The apparel industry seems to be as hungry as other industries for this type of approach to research and technology extension."

Companies linked with this center include VF Corp. and its Vanity Fair and Lee subsidiaries, Oxford Industries, Riverside Manufacturing, Russell Corp., Tennessee Apparel, Warner Featherbone and Wilkins Industries.

"We are here to help the industry at large," said Adams. "One of the companies that is very active doesn't make trousers — they make undergarments for women — but they are interested in doing things more cost effectively, and that is the common thread."

Client

Acworth/Kennesaw Neighbor  
Name of Georgia Newspaper

SEP - 8 1988

Date

## Tech weaves new place in textile industry

A \$4 million federal shared grant to Southern Tech and Georgia Tech, aimed at revolutionizing clothing production, will make the local college famous in the world of textile and apparel manufacturing, one college official said.

The grant, will establish a Federal Apparel Demonstration project on the Southern Tech campus to show clothing manufacturers the most efficient way to mass produce trousers the military buys in large quantities.

The federal money will be used to help pay for construction of the W. Clair Harris Apparel and Textile Center now under construction at Southern Tech.

"The project identifies Marietta as a center for apparel manufacture," said Lawrence T. Haddock, head of the Apparel and Textile Engineering Technology Department at Southern Tech. "It will attract industry leaders from throughout the country and even the world."

At the same time, Southern Tech students benefit from the opportunity to work with the most up-to-date technology available in the industry, he said.

The federal demonstration grant is one of the largest additions to the research and contract income at Southern Tech in several years. Research plays an increasingly important role at Southern Tech, according to Haddock, who is a resident of Fulton County.

College officials reported special projects and research during the 1988 fiscal year generated \$3.8 million from government and private sources.

A \$87,173 grant from the National Science Foundation coupled with a \$75,000 grant from Scientific-Atlanta, for example, paid for an antenna analysis lab in the Department of Electrical and Computer Engineering Technology.

Research projects in the physics, chemistry, and applied computer science departments also have been funded by a variety of public and private sources.



Staff photo by Tomi Chappell

**LATEST TECHNOLOGY:** Rodney Cannon will be employed at the textile demonstration center that opens this month at Southern Tech.

The apparel demonstration is the largest project so far and is expected to generate more money as a continued demonstration center and for ongoing research once the federal grant has ended, Haddock said.

The Marietta campus was one of three selected as demonstration centers in the country by the Defense Logistics Agency, the giant purchasing agency for military and government materials.

"They are just like any other customer," said Haddock. "They want to buy military uniforms at a reasonable price from competing companies."

The military is required to purchase all uniforms from domestic sources, Haddock said. And government officials have been concerned about the dwindling number of manufacturers and inefficient production methods.

The demonstration center, expected to open in mid or late September, will include a model factory and a Computer Assisted Design (CAD) design center with state-of-the-art equipment, said

Rodney Cannon, electronic technician at Southern Tech who will help staff the demonstration center.

Cannon, of Marietta, a recent graduate of Southern Tech, will be one of two technicians employed at the center when it opens later this month.

One of the main purposes of the center is to promote the technology already available in the apparel industry, said Cannon.

"We will bring it here in the model factory and show it to various companies who come to visit the demonstration center," Cannon said. "They (defense purchasing) want to promote efficiency."

Southern Tech research projects funded by government and private sources and the amount during the past year included:

- Electrical and Computer Science Technology — grants to develop an automated antenna analysis laboratory to read and plot signal strength, jointly funded by the National Science Foundation and Scientific-Atlanta, \$162,000.

# MetLife Suburban

THE ATLANTA CONSTITUTION

• Wednesday, September 14, 1988

## Southern Tech to Stitch High-Tech Jeans for U.S. Sailors

By Alma Hill

Staff Writer

The Southern College of Technology has added a component to its curriculum that will be demonstrated to hundreds of manufacturers, increase job opportunities for some of its graduates and help meet the demands of the largest purchaser of clothing in the world.

It might sound like a tall order for a Marietta college, but for the students who will design dungarees for the U.S. Navy on state-of-the-art manufacturing equipment, it all can be accomplished in a day's work.

Under a \$4 million grant awarded to the Georgia Tech Research Institute and subcontracted to Southern Tech as the research site, apparel and textile students will design and assemble the denim work pants using computers and robots.

"What we're showcasing here is the technology in hopes that American apparel manufacturers will adopt it," Larry Haddock, head of Southern Tech's apparel and textile engineering technology department, said Monday.

### Project Will Use Computers, Robots

The grant was awarded by the Defense Logistics Agency (DLA), nation's No. 1 clothing purchaser, which spends about \$1.5 billion per year on fabric and apparel for the U.S. military and government workers. DLA awarded similar grants to Clemson University in South Carolina to manufacture shirts and the Fashion Institute of Technology in New York, which will make tailored military uniforms.

The manufacturer of the dungarees will be at Southern Tech's W. Clair Harris Apparel and Textile Center of Excellence, a \$3 million, 2,100-square-foot building that is to open Sept. 26. The center was named after the late W. Clair Harris, an apparel manufacturer who owned the Carwood Co. in Winder, Ga. Students enrolled in the program will have an opportunity to use \$1 million worth of the latest cutter, spreader and assembly

equipment, which was donated to Southern Tech by more than a dozen Georgia apparel and textile companies.

The DLA contracts with nearly 500 manufacturers each year to produce about 300,000 Navy dungarees and other military garments.

The long-term goal of the project is to make sure a strong industrial base is in place in case of war or military action, said Dan Gearring, an industrial engineer for DLA's Manufacturing Research Office in Alexandria, Va. "To do that,

we have to have manufacturers

who can compete on the basis of advanced manufacturing technology which, in turn, equates to better quality, faster deliveries and lower prices," he said. So far, 400 manufacturers throughout the country have indicated an interest in seeing demonstrations of the method at Southern Tech.

The high-tech method of mak-

ing dungarees begins with a computer, which generates a set of patterns and electronically arranges them on fabric images. After a plotter prints the pattern to size, computerized cutters will cut it out. Robots will then separate fabric, deliver it to sewing machines and inspect the finished product. The actual sewing will be done by about 25 students and garment workers. Barring any computer breakdowns, it should take about 22 minutes to assemble a pair of dungarees, compared with the 30 minutes it normally takes.

He said the advanced program will make students' skills more marketable after graduation. "When they're ready to leave school, the industry is really going to want to hire them because of their working knowledge of the equipment," he said.

The average student has about six job offers upon graduation, he added.

Georgia is the fifth-largest apparel producer in the United States, and the industry is the second-largest employer in the state, Mr. Haddock said.



JOE MCTYRE/SIEM  
Carol Ring, a research technician at Southern Tech, designs a pair of dungarees by using high-tech methods to be demonstrated at the school under a \$4 million federal grant.

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Name of Georgia Newspaper

SEP 29 1988

Date

## ~~Southern Tech to unveil Harris apparel center~~

The Southern College of Technology will unveil its state-of-the-art apparel and textile laboratories to the community Monday when officials cut the ribbon to open the W. Clair Harris Apparel and Textile Center of Excellence.

In addition to laboratories and classrooms, the \$3 million center will house a demonstration project, including a model factory for the Defense Logistics Agency, the world's largest purchaser of clothing.

Opening ceremonies, scheduled for 2:30 p.m. at the Marietta campus, will feature guest speakers, George Berry, commissioner of the Georgia Department of Industry and Trade and Dr. H. Dean Propst, chancellor of the University System of Georgia.

The U.S. Army Ground Forces Band will perform at 2 p.m. and the public is invited.

Berry, appointed commissioner in 1983 by Gov. Joe Frank Harris, works closely with the governor in the state economic development program. His department serves as a focal point for attracting new industry to Georgia and for supporting existing industries.

Dr. Propst will speak about the opening of the 21,000 square-foot building, which is being used as one of three federal apparel manufacturing demonstration centers in the country.

The participation of both Berry and Dr. Propst on the program underscores the relationship between education and industry that resulted in the W. Clair Harris Center. The Governor's Research Consortium provided \$1.6 million for the physical plant while apparel and textile companies donated \$1 million in equipment for use in five of the center's six laboratories.

The center also was funded by a \$500,000 gift from Mrs. Reunette Woodruff Harris, widow of the

apparel industry pioneer W. Clair Harris, for whom the building is named.

A \$4 million federal grant will finance the demonstration project in the new building. The project, which will be a joint effort by Southern Tech and Georgia Tech, will establish a model factory for the manufacture of military Navy denim pants.

Manufacturers have donated state-of-the-art equipment to show clothing manufacturers the latest technology available in the textile and clothing industry.

Visitors to the center can watch computers cut clothing patterns and robots stitch seams. A 3,000 square-foot apparel assembly center features latest in cutter, spreader equipment.

is designed to provide technology that already is available and to help develop new technology for an even more efficient apparel manufacturing process.

Although federal sponsors have awarded the grant to promote more efficiency in the clothing industry and better prices for the clothing they must purchase, the new center also will provide benefits to students who attend Southern Tech.

"One of the prime reasons for the lab being located on our campus is to show students how this industry has changed and has become more high-tech," said Larry Haddock, head of Southern Tech's Apparel and Textile Engineering Technology department. "These will be the labs we teach from, so students will have the opportunity to put their hands on all of this new technology."

The 21,000 square-foot building also features classrooms, a temperature-controlled textile testing laboratory, a textile manufacturing process lab, a personal computer lab and a 100-seat lecture hall.

# Happy 40th, Southern Tech!

Known as the "Technical Institute" when it opened its doors on March 12, 1948, Southern Tech was founded to bridge the gap between skilled craftsmen and the engineer. The Georgia Business and Industry Association asked the Board of Regents to set up a school to train technicians, and Southern Tech began with 116 students at the Naval Air Station in Chamblee. According to the 1949 "Technician's Log" yearbook, the original home of Southern Tech seemed to meet the initial needs:

"Although there is no educational connection with the Navy, the services rendered by the Navy have been invaluable. The facilities include two fine dormitories, four large laboratory and shop buildings, a maintenance building, a fine gymnasium and, in fact, everything needed by a modern college."

Mr. L. V. Johnson was director of the school during that first year when it operated as a two-year engineering technology division of the Georgia Institute of Technology.

One student in particular stood out among the students enrolled during that first year. David Summers won a scholarship based on a thesis titled, "Why I Enrolled at The Technical Institute." Summers received his associate degree from Southern Tech, and his bachelor and master's degrees from



Southern Tech President Dr. Stephen Cheshier (R) admires the school's 40th birthday cake during April ceremonies with former Southern Tech directors L. V. Johnson (C), (1948-58), and Hoyt McClure, (1959-70). The outdoor party was attended by staff, faculty, students and friends of the school.

Georgia Tech. He is now department head of ECET and has had enormous influence in the lives of Southern Tech students throughout the past years.

Wade Woodward III was one of the first students to register at "The Technical Institute." Fifteen years ago, Woodward, a technical illustrator at Lockheed, wrote his memories of the early days. He was art editor of the first yearbook and his sister, actress Joanne Woodward, was pictured in the

first edition as a "sponsor" — or, in other words, a pretty female face in the sea of all male students pictured within the pages of the "Technician's Log."

"Our first co-ed, Barbara Hudson, came in the summer of 1948 from Brown High School in Atlanta," wrote Woodward. "She majored in building construction and was an honor student. She was so tiny that she had to carry a box around with her (to stand on) when she went on surveying field trips."

"After leaving Southern Tech, I returned to Clemson to continue my studies in architectural engineering." Woodward continued to write. "Of the two schools, I'll have to admit that I enjoyed Southern Tech much more. We were small, we were founders and the pioneers of this new type of school. We had our ups and downs but we weathered the storm. Our graduates were well thought of wherever they went."

In 1949, Southern Tech moved quickly to become the "Southern Technical Institute" and was recognized as a college-level school by the U.S. Department of Education.

## The 1950's

The '50's decade brought continued growth and change to the DeKalb County campus known as Southern Tech. But there was a need to establish an identity—a need for the college to have its own roots and home soil. In 1958,



Students from Marietta's Park Street Elementary School were on hand to sing a special rendition of "Happy Birthday" to the school during the April party. Park Street is Southern Tech's "Partner in Education" through a program with the Cobb Chamber of Commerce.

Continued on Page 15

# New Apparel/Textile Center Gives Southern Tech National Exposure

The \$3 million W. Clair Harris Apparel and Textile Center of Excellence opened Sept. 26 on the Southern Tech campus and represents a unique opportunity for the college to gain national exposure for its part in ensuring that "Crafted with Pride in the USA" dominates the apparel and textile markets of the future.

The 21,000 square-foot center includes classrooms, labs, a 100-seat lecture hall, a student personal computer lab and office space for college's apparel and textile engineering technology programs. Building architects Warren Epstein and Associates designed the facility with a striking roofline, wine-colored split face blocks and Italian tile floorcovering and positioned it on a gently sloping hill which has been sited as the focus of a newly-created campus mall area.

The contemporary building will showcase state-of-the-art equipment for the apparel and textile industries, which have a major impact on America's free enterprise system. One out of nine manufacturing jobs in the U.S. is provided by textile or textile-related firms. Textile manufacturing, sales and service is Georgia's largest industry. And that industry is in need of new technology.

Southern Tech and Georgia Tech contracted with the government's Defense Logistics Agency (DLA) to establish one of only three special apparel technology demonstration programs in the nation at the W. Clair Harris Center. The U.S. military is the world's largest producer of clothing, and concern over increasing levels of apparel imports, increasing costs for domestic manufacturing and plant closings in the U.S. convinced the federal government to provide these demonstrations to encourage companies to adopt new technology.

"We'll be able to show how all of these came together to make a product — you can't see that at a trade show," said Larry Haddock, department head of Southern Tech's apparel and textile engineering technology program. "This represents American state-of-the-art, and we expect tours from around the world."

The center allows industry visitors to visit a 3,000 square-foot apparel assembly lab and see a high-technology manufacturing process from design to finished product in a single location. The product will be Navy denim dungarees, and the processes will include the latest



*Apparel and textile classes like this one, led by ATET department head Larry Haddock (R), will be held in the new W. Clair Harris Apparel and Textile Center.*

in cutter, spreader and assembly equipment. Also included in the center is a research and development lab. Faculty, technicians and students make up the research staff who will look at flexible manufacturing systems, machine vision and robotics, product quality control and other topics.

The unique aspect of the W. Clair Harris Center is the unique cooperation between public and private sectors to make it possible. The Georgia Governor's Research Consortium provided the \$1.6 million for the physical plant, and apparel and textile companies donated over \$1 million in equipment for the center's laboratories. The federal government provided a major demonstration grant to the center, and Mrs. Reunette Woodruff Harris, widow of apparel industry pioneer W. Clair Harris, donated \$500,000 — the largest single gift to Southern Tech.

"This has been a joint effort between state and federal agencies, industry and a private individual — I don't know many projects with those kind of unique working relationships," Haddock said, adding that another reason for the center is to show students how the apparel and textile industries have changed and are becoming more high-tech. "Our students will be working on the actual equipment used in the industry and gaining valuable hands-on experience. They are an important link in this transfer of technology in these industries."

The late W. Clair Harris was a pioneer in the apparel industry. A resi-



*Cumming artist Gregory Johnson puts finishing touches on the oil portrait of Mr. W. Clair Harris which will hang in the lobby of the new 21,000 square-foot building.*

dent of Winder, Ga. he served as president of the American Apparel Manufacturers Association and of the Southern Garment Association. He was a founder, president and chairman of Carwood Manufacturing Co., a major manufacturing organization with six plants in Georgia and sales offices throughout the nation. In 1987, because of the continued support of the Harris family in Southern Tech's apparel and textile engineering programs, the Board of Regents at the University System of Georgia approved the school's request to name the new facility the W. Clair Harris Apparel and Textile Center.

An oil portrait of Mr. Harris is displayed in the center lobby. The painting was created by noted Georgia artist Gregory Johnson.



# INDUSTRY GOES TO SCHOOL

Three universities to host new DLA demonstration centers □ by Jim Beecher

**W**hile September to some means relief from a long, hot summer, to others it signifies another event: the beginning of the school year. This fall, three universities will bring the apparel industry back to the classroom to learn more about new technology and incorporating this new information into the real world of manufacturing.

The Advanced Apparel Manufacturing Technology Demonstration Project (AAMTD) will make its debut at the three universities chosen by the U.S. Defense Logistics Agency (DLA) of the Department of Defense. The Fashion Institute of Technology (FIT) in New York, Clemson University in Clemson, S.C., and the Georgia Institute of Technology in Atlanta, all will have operating apparel demonstration plants this fall, though each will open at different dates.

Each demonstration center will manufacture a different type of military garment using the latest equipment and calculating how the private industry can incorporate this machinery into their own plants. "We want to increase U.S. manufacturing technology by having the industry use these universities as a resource to establish a healthy industrial base," says Dan Gearing, industrial engineer and DLA contracting officer representative, which, as he says, is a fancy title to say he monitors the day-to-day progress of each plant.

The idea for the project arose from a Department of Commerce study on import competition conducted a couple of years ago. The study concluded that the U.S. apparel industry was not using advanced apparel manufacturing techniques. It suggested the AAMTD project as a solution that would offer improvement in four areas:

**1.) Education.** "People do not know how to integrate new information into their plant," Gearing says. "This project will show them how."

**2.) Interest.** Before the project, there was no place for a college student to get ex-

perience and learn about the industry; therefore, fewer were going into the business. "Now the project provides a cadre of men and women to enter the industry," Gearing claims.

**3.) Extension agent.** "In the past, it's been tough to get reliable advice that the manufacturer knows he can trust as being useful to him. This project will be able to answer any questions manufacturers might have regarding the industry," Gearing says.

**4.) Research.** "How do we develop for the future? This has always been a concern for the industry. We now have a way of answering this," Gearing concludes.

The three project sites were selected from a field of nine schools that submitted proposals. Each of the three will receive \$666,000 for the first year, \$333,000 for each of the following two years and an optional \$333,000 per year for the fourth and fifth years, if the DLA decides to continue the funding.

In addition, extra funds will be allotted for short-term research projects. Research topics being considered for funding include computer-integrated manufacturing; management and vision systems; economic analysis; simulation; flexible work cells; in-process quality control; textile-apparel interface; facilities, labor and production planning and forecasting; utilization of Kawabata Evaluation System data in apparel manufacturing; data base design; supervisor training; low ply cutting; measurement of work-in-process; and cost measurement systems for automated apparel manufacturing.

"These funds will be allotted individually, according to the project presented," Gearing says. These funds will average anywhere from \$100,000 to \$1 million.

In addition to the three schools, North Carolina State University in Raleigh, N.C., was awarded a contract last year to study flexible assembly systems. "They will study systems that are modular in nature, that can be reconfigured to perform a range of tasks in apparel manufacturing," Gearing ex-



plains. "They also are doing fundamental research on ply separation."

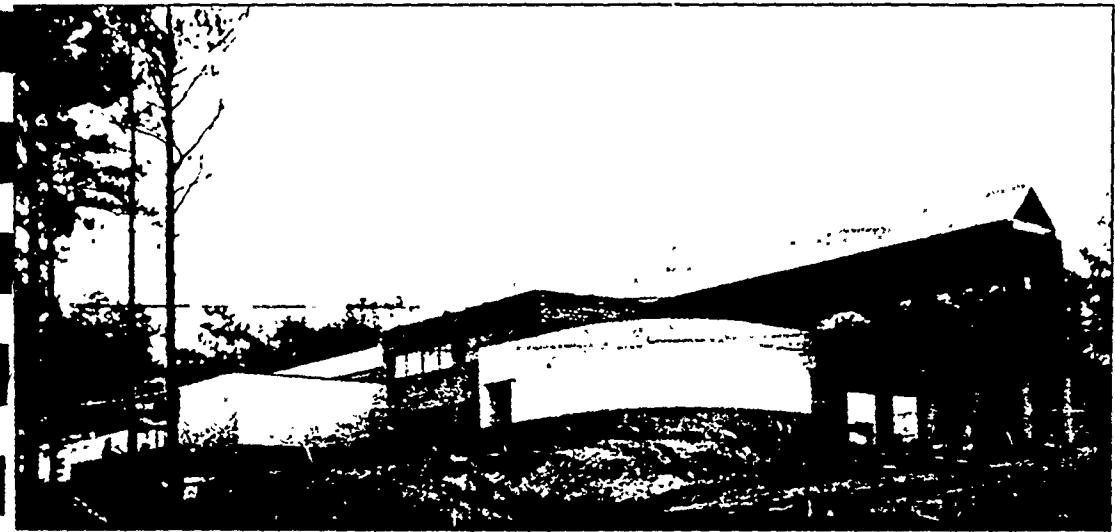
In all, Gearing says the DLA has achieved its objective of providing a resource for manufacturers in advanced apparel technology. "We feel that this investment will pay off in the future. We need a cost-effective industrial base."

Each school has been assigned a different product to research in constructing army apparel. Therefore, while similarities will exist between the three programs, their research will be decidedly different. One similarity is that all will be open to the public.

**F**IT will produce military dress trousers in its 6,500-sq. ft. demonstration room. There is also a 600-sq. ft. room for computer equipment.

Hank Seesselberg, manager of the

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The demonstration center (top) for Georgia Tech is located on Southern Tech's campus. Clemson's center (above) is located three miles off-campus. To the left, FIT director Hank Seesselberg and technician Henry Smith make adjustments to the Gerber 91 Cutter.

AAMTD center at FIT, says he is planning for a Sept. 8 opening, when DLA officers and various state officials are invited for a private grand opening demonstration. After that, interested manufacturers are encouraged by Seesselberg to call and arrange a date to see the plant.

"As of right now, we don't have a formal schedule of demonstrations or seminars. Once we get operations under way, we should have a list of events to come," says Seesselberg, an industrial engineer with more than 20 years experience.

Seesselberg says the DLA is funding about 60% of the project, with the rest coming from FIT and industry cooperation. "Of course, the state contributes indirectly, since FIT is a state university," Seesselberg adds.

He has been spending the last couple of months ordering equipment and ensuring

that the center will open on time. One of the requirements for the equipment selected is that the machinery is available for U.S. manufacturers. This became somewhat of a problem for Seesselberg. "We went through a long period of choosing equipment. At Cologne (IMB Show in Cologne, W. Germany), we saw some really interesting machinery. Unfortunately, some of this stuff is not readily marketable here in the United States. I saw a lot of equipment I'd like to have, but we are required to demonstrate equipment that is marketable in the United States."

Equipment that FIT has been fortunate to obtain, mostly through contributions, includes computerized sewing machines with thread trimmers, an auto-serging machine, a side seamer, pocket hangers, a buttonholer, belt-loop machines and automated cutting machines, all state of the art.

Military garments are produced in the projects for two reasons, Seesselberg says. The first, logically, is because the Department of Defense is funding the project. But the second has to do with the fact that private industry might not want to show their operations to the public — or their competition. Therefore, since military specifications are public information, there should be no problems.

Unfortunately, there still are a few complications. Sometimes, military specs do not match the private industry's; therefore, to show a military technique would be a waste of time. So, as Seesselberg explains in this particular example, adjustments have to be made. "Military specifications have been of sewn-canvas construction. But we're going to be moving toward fusible garments in our program, be-



**T**he men behind the project: on the left are (l. to r.) Southern Tech's Larry Haddock, DLA's Dan Gearing, Georgia Tech's John Adams and Southern's Dean of Engineering Bill Rezak. On the right is Clemson's project director Ed Hill.



cause this is pretty much standard in the private industry."

The center will help the industry by dealing with specific problems. "As an example, we are currently working with a local manufacturer of military dress coats to try to develop a program that will produce better techniques in such areas as computerized cutting," Seesselberg explains. "We will measure the effects here and see if this technique is adaptable to him."

While seminars are planned to be offered at the center, Seesselberg says they are on the back burner until next year. "We hope to cover topics like computerized cutting, unit production systems and programmable computer-controlled sewing machinery. We will have demonstrations and speakers, as well as a chance for the manufacturers to try their hand at operating the equipment. This is where they really learn — by trying the equipment out themselves."

Seesselberg says military trousers are only the beginning at FIT. By mid-1989, the center also will be producing military dress coats.

Clemson University will begin making shirts in its 6,000-sq ft demonstration area by Nov. 1, if plans go as scheduled. An open house is set tentatively for Nov. 4. Plant manager Ed Hill says the 30,000-sq. ft. building, located about three miles from the main campus, is ideally suited for the project.

"We're very excited about the program here. The building will serve as a model plant for manufacturers, offering the latest in technology and the very best equipment."

That equipment, specifically, will include top-of-the-line models in a cutting table, a spreading machine, an automated cutting machine, an automated top-stitching machine, automated button and buttonhole machines, engineering and costing systems, a unit production system, an automated warehouse system and guided vehicle and a marking, grading and pattern design system.

"We have an agreement with the companies that have donated equipment to have them continually update the machinery," says Hill, an industrial engineer who has been in the apparel business for 16 years. "For example, we will be getting the new Eastman spreading machine after it makes its debut at the Bobbin Show this month."

In addition to the DLA funding, the Clemson project will receive grants from the state and the university. Hill says the state will contribute almost \$1 million, while the university will follow suit with almost \$900,000.

Hill says he can only see beneficial results from the program. "One of the biggest advantages in this project is the fact that we have a fully functional plant but no daily production requirement. We can break down the process step-by-step and study it carefully."

Hill also offers another reason why the center will be so valuable for manufacturers. "The information that we will be providing to the public will not have a sales pitch to it, just the facts."

Hill says the center will hire seven full-time employees, including himself. There also will be 15 faculty from the university who will spend time there. In addition, the manager estimates about 35 part-time employees will be working "on an on-call basis," depending on the various short-term projects being conducted.

Hill says preparations are under way for a seminar program. "We are planning to have our first seminar in either November or February, depending on scheduling," the director says. "It will be on the subject of apparel manufacturing. After this broad-based seminar, our purpose will be to narrow our focus to more specific topics with more detail. Eventually, as we obtain more information, we will conduct seminars on our research, and I'm sure these will be very desirable for manufacturers."

**T**he Georgia Tech program is unique in its organization. While the DLA contracted with the Atlanta-based school to

research and construct trousers, a subcontract was signed with the Southern Institute of Technology, located 12 miles north of Georgia Tech, in Marietta, Ga. The Claire Harris Center of Excellence of Textile/Apparel Manufacturing will house the demonstration facility. Included will be a 4,200-sq. ft. demonstration room and an 800-sq. ft. computer equipment room.

According to program manager John Adams, the center should be fully operational by Oct. 24. The dedication of the building will be at 2 p.m. on Sept. 26.

The Georgia Tech program has been divided into three branches. First, under Adams' supervision, the Georgia Tech Research Institute will deal with the administrative side, making sure that all areas of the DLA contract are covered. The second branch is Georgia Tech's Textile Engineering School, headed by Wayne Tincher, Ph.D. This branch will deal with the research efforts of the project. The third branch involves the Apparel/Textile School at Southern Tech, under the direction of Larry Haddock, Ph.D. This branch's main responsibility is the plant operation. It also will be involved in some of the research.

In addition to DLA backing, the Georgia Tech project was funded partially by the state, which helped finance the building at a cost of about \$1.6 million.

This program received much of its equipment through industry contributions, as well. Some equipment to be used includes a robotic two-dimensional sewing machine, a unit production system, an automated cutting machine, a marking, design and pattern system and a shop floor control system. The plant will operate on a PC system.

"We are on our way to becoming 'fully automated.' Of course the phrase 'fully automated' should be in quotes because people will still be involved in some aspects," Adams points out. "People are still the best way of doing some things."

Tincher, head of the research branch, says two short-term projects already have received approval from the DLA for funding.



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COMPUTER  
SYSTEMS, INC.

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**ACS SOFTWARE CHOSEN FOR "APPAREL FACTORY OF THE FUTURE"**

**Georgia colleges' new Apparel Manufacturing Technology Center  
to showcase integrated manufacturing system.**

ATLANTA, GA, BOBBIN/AAMA SHOW, September 27, 1988 -- Apparel Computing Systems (ACS) has been chosen by Georgia Institute of Technology to supply software for the school's Apparel Manufacturing Technology Center. The Center, funded by the Defense Logistics Agency of the Department of Defense, will include a "factory of the future" -- a \$2 million demonstration facility showcasing the most advanced technology available to the apparel manufacturing industry.

The Center, a joint venture of Georgia Tech and Southern College of Technology, will be located at Southern Tech's campus in Marietta, Georgia. The project's twofold purpose is to improve the manufacturing capability of the U.S. apparel industry, and to advance the state-of-the-art in apparel manufacturing.

## GEORGIA TECH CHOOSES ACS SOFTWARE

2

ACS software, including ACS On-Line and IPCS (Integrated Production Control System), will drive the entire manufacturing operation from design to cutting and sewing. In a demonstration of the state of the art in real-time shop floor control, the software will be integrated with Gerber design and production equipment and the Redifacts real-time data collection system to coordinate data from CAD stations and sewing stations.

In addition, ACS will participate with Georgia Tech in a \$3 million research and development program. Research areas include development of an architecture for total computer integrated manufacturing, development of "flexible workstations" capable of handling more than one manufacturing operation, and on-line garment quality control.

"Information management and systems control offer substantial benefits and opportunities for the apparel industry. As the apparel environment gets more and more complex, industry executives and plant managers will need computer assistance for decision making and in plant operations," said John Adams, director of the Apparel Manufacturing Technology Center.

"We are extremely pleased to have been selected by Georgia Tech to take part in this important step towards bringing the U.S. apparel industry into the 21st century," said ACS Senior Vice President Randall King. "This cooperative venture will go a long way towards modernizing the industry and putting the U.S. back in the forefront of the apparel world."

## APPAREL COMPUTER SYSTEMS

Apparel Computer Systems, Inc. (ACS), founded in 1978, is a leading supplier of software and services for the apparel industry. Its products help apparel manufacturers to control their businesses, keeping costs down and profits up to maintain their competitive edge. Headquartered in Concord, CA, ACS has regional offices in Manhattan, Atlanta and Los Angeles.

# # # #

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APPAREL CENTER BUILDING TO BE DEDICATED

The building tailored for a new apparel manufacturing center at the Southern College of Technology will be dedicated Monday, Sept. 26, 1988 on the Southern Tech campus in Marietta.

The Apparel Manufacturing Technology Center (AMTC), operated jointly by Georgia Tech and Southern Tech, will test and evaluate high-technology manufacturing processes and systems, provide engineering students with hands-on experience, conduct apparel-related research, and address needs of member companies. The overall purpose of AMTC, one of three such centers sponsored by the U.S. Defense Logistics Agency (DLA), is to increase the vitality of the American apparel industry.

Initially, AMTC will produce military and civilian trousers, but it plans to manufacture other products in the future. It will hold regularly scheduled manufacturing tours, the first occurring this October.

Among those expected to attend the ribbon-cutting are Georgia Lieutenant Governor Zell Miller, Representative Buddy Darden (D-Ga.), and DLA officials. The ceremony is scheduled for 2 p.m.

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APPAREL MANUFACTURING CENTER HOLDS FIRST DEMONSTRATION

The Apparel Manufacturing Technology Center (AMTC), a joint effort of Georgia Tech and Southern Tech, will hold its first equipment and systems demonstration Oct. 24 from 4 to 6 p.m. Touring industry representatives and government officials will witness production of blue jeans by high-tech manufacturing processes.

AMTC is housed in the W. Clair Harris Textile/Apparel Center of Excellence at Southern Tech in Marietta.

Sponsored by the Defense Logistics Agency, AMTC not only tests and evaluates commercially available apparel-related high technology, it gives students hands-on manufacturing experience and conducts research relevant to the apparel industry. It is one of three federally backed apparel manufacturing centers and the first to reach the demonstration stage.

As AMTC acquires more equipment and refines its operation, it will hold additional demonstrations, says Georgia Tech's Susan Griffin. The next is scheduled for January 1989.

dent.

Verret also observes that countries in the Far East have maintained their labor cost competitiveness against the U.S. and have improved their competitiveness with the Common Market countries. The exception is 20th-ranked Taiwan, where hourly wages increased from 23% of U.S. labor costs to 31%, or \$2.94.

A comparison of mill operating hours suggests a trend for increased mill operating hours per year, although this varies from country to country. Textile plants in Sweden operate the fewest annual hours—5,100—and plants in Taiwan operate the most—8,396. Average U.S. annual plant operating hours in the U.S. is 7,320.

While some companies run longer hours than the average shown for each country, all high-wage countries are at a disadvantage compared to most of the low-wage countries, says Verret. "It is quite obvious that with the capital investments required for a new textile plant, it must be planned to operate at least 8,000 hours per year to get the full benefit of the investment," he calculates.

The Spring 1988 survey covers 48 of the world's leading textile producing nations, excluding countries of Eastern Europe. Labor cost comparisons are in U.S. dollars (including social charges) based on May 27 exchange rates.

### Fiber association changes name

The Man-Made Fiber Producers Assn. has changed its name to the American Fiber Mfrs. Assn. Inc. The new name was formally adopted at the group's annual meeting in Williamsburg, Va.

The association represents companies that produce some 90% of the manufactured fibers, filaments and yarns in the United States.

### Felker recognized by Atlanta Textile Club

The announcement of Stephen Felker as the Atlanta Textile Club's Person of the Year brought some 300 members and guests to a standing ovation at the club's



### Southern Tech dedicates new textile center

Funded by federal and state governments, private textile and apparel companies, and Mrs. Reunette Woodruff Harris, Southern Tech's new textile/apparel center in Marietta, Ga., celebrated its grand opening in September. The \$2-million W. Clair Harris Apparel & Textile Center of Excellence is named for Mrs. Harris' late husband who is described as "an apparel industry pioneer."

The center received modern equipment from more than 12 companies, including Gerber, Zellweger Uster and Coats & Clark. Fall 1988 enrollment in Southern Tech's textile engineering program has increased 100%, and enrollment in the apparel program is up 40%—largely attributed to the new textile center.

annual awards dinner in October.

Felker was recognized for his "optimism" and for "having the greatest positive influence" on the textile industry, says Dan O'Keefe (Thomaston Mills), the club's president. In his acceptance speech, Felker acknowledged that he is "optimistic" but not "blind to the problems of the industry."

The awards dinner coincided with the Bobbin Show and with the Atlanta Textile Club's annual golf and tennis outing.

### Bitensky receives Torch of Liberty award

Samson Bitensky, president and chairman of Fab Industries, was presented the Torch of Liberty Award of the Anti-Defamation League of B'nai B'rith at a luncheon hosted by ADL's Textile Industry Div.

Bitensky was honored "for his accomplishments in the business world as well as his activities on behalf of educational, medical and community organizations," said luncheon chairman Frank Greenberg, CEO of Burlington Industries.

### Delta Woodside integrates Stanwood

Delta Woodside Industries has begun a consolidation plan that integrates its operations with Stanwood Corp., a recently acquired apparel company.

Erwin Maddrey, Delta Woodside's chairman and CEO, hopes the consolidation will turn around Stanwood's losses, which came to \$4.15-million last year due primarily to problems with fleecewear sales. The plan involves...

...closing Stanwood's Charlotte headquarters.

...consolidating headquarters of Stanwood's Knoxville, Tenn.-based Standard Knitting with Delta's Royal Mfg. in Greenville.

...consolidating knitting, dyeing and finishing in Malden, where the company is investing \$6-million in new equipment.

...closing Stanwood's Tellico Plains (Tenn.) dyehouse and moving equipment to Malden.

...completing a new \$30-million plant in Spartanburg, scheduled for start-up in May, to make yarn for Standard Knitting and Royal.

## Apparel Center Holds First Demonstration

The Apparel Manufacturing Technology Center, a joint effort between Georgia Tech and Southern Tech, held its first equipment and systems demonstration on Oct. 24.

During the demonstration, touring industry representatives and government officials witnessed the production of blue jeans by high tech manufacturing processes.

The AMTC is housed in the W. Clair Harris Textile/Apparel Center of Excellence at Southern Tech in Marietta.

Sponsored by the Defense Logistics Agency, the center not only tests and evaluates commercially available apparel-related high technology, it gives students hands-on manufacturing experience and conducts research relevant to the apparel industry.

It is one of three federally backed apparel manufacturing centers and the first to reach the demonstration stage.

As the center acquires more equipment and refines its operation, it will hold additional demonstrations. The next is scheduled for January 1989.

AUGUST 1988

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**Defense Dept. Funds  
Apparel Project**

The Defense Logistics Agency of the Defense Department has funded an apparel manufacturing project to demonstrate the advantages of using advanced technological methods and equipment in domestic apparel production.

The Advanced Apparel Manufacturing Technology Demonstration Project (AAMTD) is now under way at three universities: Fashion Institute of Technology, Manhattan; Georgia Institute of Technology, Atlanta; and Clemson University, Clemson, S.C.

The New York site functions as a demonstration center where tailored clothing is produced using high-technology equipment. The center welcomes visitors and will let them operate the equipment. Currently, the center is digitizing trousers patterns for computerized marker-making.

Other specific short-term projects at the center include developing a comprehensive supervisor training program, justifying low-ply cutting, and utilizing computer software for tracking work-in-process and quantifying through-put time.

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Volume 5 Number 2

## Apparel Manufacturing Technology Center Opens

A new \$5-million apparel research and demonstration center operated jointly by Georgia Tech and the Southern College of Technology opened October 21 with a pilot-scale demonstration factory set up to manufacture blue jeans using state-of-the-art equipment.

Located on the Southern Tech campus in Marietta, the center will be used to evaluate and integrate new equipment, develop new technology, and provide hands-on training for students.

Approximately half of the American apparel market has been captured by foreign manufacturers, who have lower labor costs and other advantages. Operators of the new Apparel Manufacturing Technology Center hope to chip away at those advantages through robotics, automated material handling, machine vision, computer design stations, and other new technology.

"We believe we can help the American apparel industry become more competitive by showing them how to use

automation and new technology to increase their productivity and capability to respond quickly to fashion and design changes," says Program Director John Adams of the Economic Development Laboratory. The demonstration plant at the Center will allow companies to see modern equipment interfacing with plant processes and simulate how it might work in their own facilities. Larry Haddock of Southern Tech manages the Center.

Funding for the new Center comes through the U.S. Defense Logistics Agency (DLA), which is responsible for providing the materials needed by the U.S. military. The DLA is concerned that the loss of U.S. apparel manufacturing capacity might limit supplies to U.S. forces in the event of a major mobilization. The agency also is the single largest purchaser of apparel in the free world.

DLA also sponsors apparel manufacturing centers at Clemson University in South Carolina and at the Fashion Institute of New York.

November-December 1984



Among the high-tech equipment demonstrated at the opening of the Apparel Manufacturing Technology Center is the Gerber S-95 high-speed cutter shown here. A student shows visitors how the Gerber system automatically spreads and then cuts one or two ply fabric held under vacuum. A marker making system drives the programmable cutter. (Photo by Gary Meek)

Industry response to the Georgia Center has been strong. A 12-member steering committee advises the Center on its research agenda, which is focused on projects with immediate results. More than 450 plants have expressed interest in participating in the Center, and Adams hopes to organize a 100-company coalition that would guide the efforts, share research results, and offer opportunity for testing.

The ravaging of the American apparel industry by imports has not gone unnoticed by the Defense Department.

Worried that the shrinking American manufacturing base may be unable to turn out enough uniforms and other textile products — such as tents and canteen covers — in time of war, the Defense Department has come up with \$18 million to establish three centers that will demonstrate the latest technology for making clothes.

The objective, according to Defense Logistics Agency spokesman Earl Nichols, is to increase the use of high technology in apparel manufacturing, thus strengthening the nation's industrial base.

Three universities — Fashion Institute of Technology in New York, Clemson University of Clemson, S.C., and Atlanta-based Georgia Institute of Technology — last fall won competitively bid contracts to create such centers, and are now working to beg, borrow or buy the most advanced equipment available.

The contracts allot each of the centers up to \$6 million over a five-year period, depending on the short-term research projects they conduct, and they must secure in-kind contributions of time or equipment from the industry.

The goal is to have the three facilities ready to demonstrate state-of-the-art apparel production technology by September.

Though meeting military needs is the main impetus for the program, the equipment at these centers will in most cases be suitable for making civilian apparel as well.

"We hope the bridge can be made between military and civilian industries," said Henry Seeselberg, a veteran Singer Co. engineer who last fall joined F.I.T. to manage the new center.

"We will try to make it an informal and friendly environment, so garment manufacturers can come in and literally play with the equipment to see how it would fit with their operations."

Jack Peck, a computer science professor who coordinates Clemson's program with textiles professor Christine Jarvis, said small

# U.S. Puts Up \$18 Million to Fund RTW Technology

companies are the ones that will benefit the most from the center.

"This will provide a neutral site for them to see (the equipment) in production," he pointed out, adding that the firms might not otherwise have that opportunity. "Lots of times," he said, "competitors hesitate to let other people see what's going on inside their shop."

The centers will set up miniature factories to demonstrate the process of automated production for specific apparel.

F.I.T. is procuring advanced technology for making tailored clothing for dress uniforms, including trousers, jackets and overcoats. Clemson University is working on shirts, while Georgia Tech will automate production of utility and combat-type trousers.

The types of systems on display will include unit production machines, computer cutting machines, long-seam contour seamers, programmable computer-operated sewing stations, automatic pocket welters, automatic dart seamers, and automatic fly stitchers, said F.I.T.'s Seeselberg.

A major hurdle, he



added, is getting the equipment donated.

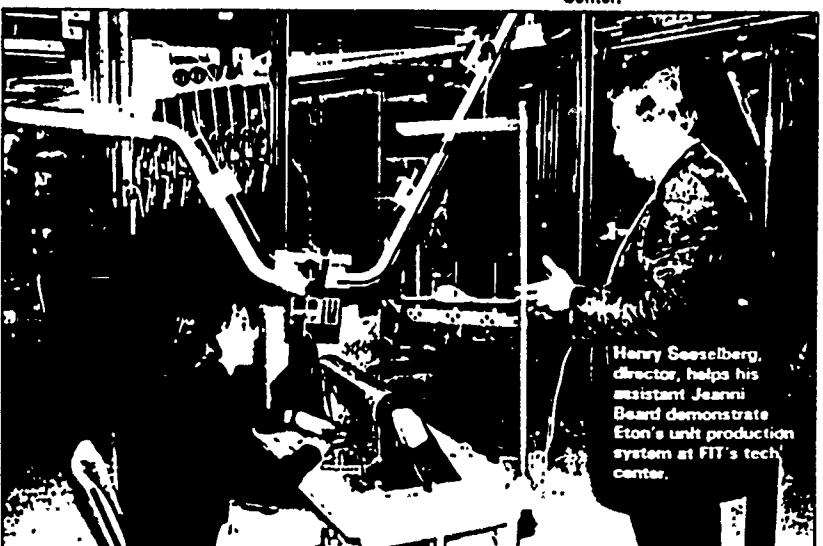
The machines, while costing anywhere from several thousand dollars to several hundred thousand dollars, reportedly can save up to 50 percent of the labor required to do the job manually.

**"Surprisingly,  
the Far East  
is buying  
advanced  
technology  
equipment.  
They're not  
dumb."**

— Henry  
Seeselberg  
(F.I.T.)

Georgia Tech is "looking at flexible manufacturing, robotics, manufacturing planning and the whole gamut of integrated computerized control systems," said John Adams, director of the program and a senior research engineer

John Adams, director of GIT's Apparel Manufacturing Technology Center.



Henry Seeselberg, director, helps his assistant Jeanni Beard demonstrate Eton's unit production system at FIT's tech center.

The so-called Advanced Apparel Manufacturing Technology Centers will try to help businesses determine whether automation can improve their operations and whether they can afford the equipment. F.I.T., for example, is researching ways to quantify the payback a business gets from automation.

"Classic economic justification methods don't handle some aspects of high technology very well," Seeselberg pointed out. "How do you handle increased versatility, skill levels, system approaches?"

Clemson University, meanwhile, is developing an "expert system" — software that can function as a financial advisor. The system will ask questions and then make recommendations about a business.

"The idea is to be able to identify the bottlenecks, to be able to balance people and machine resources," explained Jack Peck, a computer science professor who directs the center with textiles professor Christine Jarvis.

Meanwhile, Georgia Tech hopes to establish by spring an electronic bulletin board that maintains manufacturing information and is accessible by computer. With this service, Peck said, "anyone can find out what's going on in the world of apparel technology."

What characterizes the apparel industry now, he said, is a noticeable lack of automation.

"I visited a lot of apparel plants over the last several years and some of them, particularly the small ones, are very far behind the times in terms of technology," Peck commented.

Said Seeselberg, "The apparel industry is archaic in one respect. Other industries have collectively taken advantage of technology. The entire industry advances and everyone gets a piece of it. Here, everyone jealously guards what they are doing individually. There's a lot of equipment available, but its use is not as widespread as it could be."

Meanwhile, the development of high technology equipment has not been ignored by the Far East. "Surprisingly," Seeselberg said, "the Far East is buying advanced technology equipment. They're not dumb. They are starting to buy upscale equipment."

# Taking a walk around a closed garment factory

BUSINESS PLUS — March 7, 1988 — 6

Jim Scarborough took me on a walk around the almost deserted apparel plant. An auditor from the Chicago Bank of New York was busy in his makeshift office orchestrating the liquidation process. A few people were around cleaning up or counting inventory. One whole floor of modern, automated equipment was draped with protective coverings.

"I thought I could be a hero here quick," Jim Scarborough said.

But there was not enough time. Jim took the plant manager job at Thanksgiving. Seventeen work days was not enough time to turn things around at the L&H Shirt Factory in Cochran. The old cotton mill turned shirt factory in 1936 had seen better days, substantially better, being one of the biggest county employers for years.

Jim pulled back the covering on an automated pocket setter. "Hardly a piece of the equipment is old, mostly last year. Some not even dirty."

I wanted to hear from Jim about the role technology may have played in the shutdown.

"They had taken a shot at automation," he said. "Further automation may have helped, but the debt problem closed us down."

The closure of this plant and two others in Eastman came as a shock to everyone. Over 800 employees were laid off in the closures as the Christmas holiday shutdown was extended several times and then made permanent. The process was initiated on December 23 when Charles Greenberg & Sons, a New York company, filed a Chapter 11 bankruptcy.

"Look at the thread," Jim pointed with his finger. We looked all around the huge manufacturing space. "Thread is everywhere. When I came in to look around before taking the job, I noticed the thread. There's enough thread to sew for a year."

Plenty of thread and many new machines and equipment made the plant appear to be flourishing.

"No cost cutting measures were in place. We had 40 days of in-process inventory and that is too much."

Too much indeed. Many apparel experts want to see zero in-process inventory and very little raw material on hand.

"Scheduling was hit and miss," he continued. "Cut it, put it in, and hope it comes out on time."

Jim had 12 years experience in apparel manufacturing, and he felt



he knew how to get things on track, but no one told him how bad the cash flow problem was.

I told Jim I had heard a lot of concern about the garment industry. Two universities in the Southeast, Clemson and Georgia Tech and the New York Fashion Institute of Technology had been funded recently to create manufacturing centers to demonstrate advanced apparel manufacturing. The concern actually is coming from the U.S. defense planners who fret over the industry's capacity to produce uniforms during times of war. The technology that is available, they believe, is not being purchased and put on the floor.

"Everyone would like to automate their plants," he said, "but so often the equipment becomes obsolete by fashion changes." The size of the L&H Shirt Plant, he points out, is larger than what many modern apparel operations are carrying. L&H had 337 employees, and the trend is toward smaller operations like 125 or 150 people with a plant manager, a payroll clerk, a floor supervisor and two or three mechanics. Small is better for control and flexibility.

Flexibility is essential to this kind of manufacturing. The automated equipment must be adaptable in handling many assembly processes. For a pair of jeans, there are 30 to 50 operations, while jackets require 150 operations. A machine for each operation would be too expensive and complicated. When style changes, sometimes machines sit idle.

Jim fingered the manufacturer's label on the machines. "These are made in Canada. That one Germany or Italy," he said. "Asian companies are coming in, too. The reps from the domestic equipment suppliers used to live in this area, but things have changed."

Servicing equipment is a problem. There is a need for skilled technicians who can operate, adjust and repair automated machinery.

"Most mechanics in apparel plants are shade tree mechanics and learned on the job. New technologies, they lack. New thinking is necessary. Having a place to send them is critical."

The Georgia Tech Apparel Advanced Manufacturing Technology Demonstration Center will be a training factory for students and industry workers. As a coalition

between industry and Tech, it will research and evaluate manufacturing technology and management techniques.

"Oxford of Vidalia," Jim cited, "has their own R&D unit and has a training program, too, that meshes the good ol' real world with the technology world."

"The last 5 or 10 years," he concluded, "have been like the auto industry, but we are learning to fight back."

As for Jim, he will be on his way soon to one of those smaller operations, fighting back in the best way he knows how.

*David Chatham is educational coordinator for the Georgia Tech Research Institute regional office in Macon.*

# Mrs. Fields tries out an expanded menu

The cookie war in metro Atlanta is heating up now that Mrs. Fields Cookies chain is in the test kitchen.

The Park City, Utah-based chocolate chip cookie dynasty, built by Debra Fields' special recipes, is introducing an expanded menu at its new Peachtree Center and Perimeter Mall stores. The fresh Mrs. Fields Bakery Cafe is undergoing a lengthy test in metro Atlanta. The concept is being tested in 30 other shops in selected markets.

The new shops sell everything from breakfast to lunch fare. Menu items include croissants, selected pastries, bay shrimp and cream cheese sandwiches. The items that put Mrs. Fields on the map — chocolate chip cookies — are still sold throughout the day. Those chocolate chip cookies are

unprofitable operations during 1988, the Charlotte, N.C.-based chain is closing 16 restaurants in three markets including Atlanta. Four restaurants are closing here, five in Charlotte and seven in the greater Memphis area.

**IN SEARCH OF THE BETTER BLUE JEAN.** The Georgia Institute of Technology is trying to help America's apparel industry remain competitive with foreign manufacturers. At its new \$5 million Apparel Manufacturing Technology Center in Marietta, Tech is piloting a demonstration factory where blue jeans are produced using state-of-the-art equipment.

**Bottom line:** More efficient

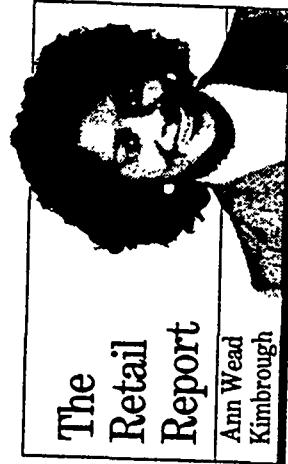
domestic apparel plants can rapidly

service the needs of their wholesale

sales we've seen recently in

Atlanta, Zayre's liquidator — Schottenstein's of Columbus, Ohio — is not announcing continual discounts on goods. Richway, for instance, began with 20 percent off then moved to 50 percent and to 90 percent by its final weeks.

**RETAIL RETREAT.** The annual Georgia Retail Association Inc.'s meeting has been moved from its traditional June dates to May 13-16 at the King and Prince Hotel and Villa on St. Simon's Island. This year's retreat is still being planned, but it's likely that bad check legislation and civil restitution for shoplifters will be among the topics discussed, says William McBrayer, president of the statewide group.



**The  
Retail  
Report**

Ann Wead  
Kimbrough

and retail clients.

More than 450 apparel plants are monitoring the trouser project's results, says John Adams, the center's program manager.

**WIMPY SALE.** No, Popeye's friend is not about to start a business. Instead, I'm referring to the ongoing Zayre Corp. going-out-of-business sale. Unlike the aggressive close-out

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FEBRUARY 16, 1989

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*3/13*  
TROUSER R&D: Georgia Institute of Technology opens a new apparel-industry research and development center. One goal is to cut trouser manufacturing time to recapture production from Asia. The U.S. Defense Logistics Agency, not wanting to be exposed to an overseas dependency in the event of war, puts up \$5 million.

AIRPORT ANGST: Corporate travel planners worry most about travelers flying through Frankfurt and London's Heathrow airports, says a Diners Club survey taken three weeks after the December bombing of a Pan Am jet. Rome and Athens headed the last such survey, taken in July 1986. //

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JOURNAL, WESTERN EDITION  
DAILY 445000

12A-1860 WALL STREET  
JOURNAL, SOUTHWEST EDITION  
DAILY 227600

12E-160 THE WALL STREET  
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FEBRUARY 16, 1989

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**TROUSER R&D:** Georgia Institute of Technology opens a new apparel-industry research and development center. One goal is to cut trouser manufacturing time to recapture production from Asia. The U.S. Defense Logistics Agency, not wanting to be exposed to an overseas dependency in the event of war, puts up \$5 million.

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# Whistle

THE GEORGIA TECH WHISTLE

VOLUME 15, NUMBER 7 • FEBRUARY 27, 1989

## New Center Helps To Revitalize U.S. Apparel Industry

By John Toon  
Research Communications Office

Operators of a new \$5 million apparel research and demonstration center near Atlanta believe they can help boost the competitiveness of America's apparel industry — using automation, new technology and modern management techniques to recapture markets lost to foreign producers.

Approximately half of the American apparel market now belongs to foreign manufacturers, who benefit from low labor costs and other advantages. Operators of the new Apparel Manufacturing Technology Center hope to chip away at those advantages by demonstrating and researching robotics, automated material handling, machine vision, computer design stations and other new technologies.

"We want to advance the state of manufacturing technology in the domestic apparel industry," explains Program Manager John Adams of

Georgia Tech. "We think there is substantial room for productivity improvements using new equipment and management techniques. We hope to break down some of the barriers that stand in the way of implementing these technologies."

Operated jointly by Georgia Tech and the Southern College of Technology, the center opened in October 1988 with a pilot-scale demonstration factory set up to manufacture blue jeans using state-of-the-art equipment.

The center's three-pronged mission will be to evaluate and integrate new equipment, develop new technology, and provide hands-on training for students.

Researchers will examine applications of flexible automation systems, computerized information systems and machine-based quality control processes, says Dr. Wayne Tincher, who directs the research efforts. While many individual processes in apparel manufacturing have already been automated, he noted, the center will take a new look at automating the overall manufacturing process.

The center's demonstration plant, located on the campus of the

**See Apparel, page 3**

## Apparel . . .

*continued from page 1*

Southern College of Technology in Marietta, will allow companies to see modern equipment interfacing with plant processes — and simulate how it might work in their own facility. The technology could make dramatic improvements in productivity, Adams believes, but because of equipment costs and lack of in-house technical expertise, many companies have been slow to embrace it.

"As companies think about investing in high technology equipment, we can put the equipment into a conceptual model of their facility and help them see whether the profitability — and low risk — are there," Adams says. "They can see whether it's worthwhile for them to consider using it."

Apparel manufacturing is a labor-intensive industry, with labor costs representing about 50 percent of a garment's cost, Adams adds. Expanding the amount of work done by each operator can therefore reduce labor cost per item and make American products more competitive.

In addition to boosting productivity, the center also has another

competitive trick up its sleeve. Pacific Basin manufacturers now require an average of nine months to produce new garments, forcing retailers to anticipate fashion trends far in advance — and gamble huge inventories that they're right.

If American producers could cut that time to two months, retailers could respond to trends rather than anticipate them, and give more business to domestic producers. With a quick response advantage, Adams predicts American apparel manufacturers could recapture 50 percent of the lost domestic market.

"They could lower that risk by reacting to changes fast enough to get the garments on the shelf in time," he says. "The retailers could afford to pay more for garments because of lower risks, meaning greater revenues for the domestic industry."



Gary Meek

*The intricacies of apparel manufacturing (in this case, blue jeans) were displayed during a recent demonstration at the Apparel Manufacturing Technology Center, located on the Southern Tech campus in Marietta.*

Funding for the new center comes through the U.S. Defense Logistics Agency (DLA), which is responsible for providing the materials needed by the U.S. military. The DLA is concerned that the loss of U.S. apparel manufacturing capacity might limit supplies to U.S. forces in the event of a major mobilization.

The DLA sponsors two other apparel manufacturing centers at Clemson University in South

Carolina and at the Fashion Institute of New York. The Georgia Tech-Southern Tech Center focuses on trouser manufacture; the Clemson center focuses on shirts, while the Fashion Institute is looking at tailored garments.

Industry response to the center has been strong. A 12-member steering committee now advises the center on its research agenda, which focuses on projects with immediate results. More than 450 plants have expressed interest in participating in the center, and Adams hopes to organize a 100-company coalition which would guide the efforts, share research results, and offer opportunities for testing.

## INTERNATIONAL BRIEFS

### Quality and Color Stand Out at Heimtextil '89

Intense pigment-drenched color overwhelmed visitors at the 19th Heimtextil home and household textiles show in Frankfurt, Germany in January, where 1,997 exhibitors from 50 countries participated.



Offbeat Gauguin-like brights — brick red, petrol blue, jade, gold — became jewel-like combined with purple, the number one color at the fair. Every variation of purple was shown, from the deepest aubergines and royal purples to light neutral grayed purples to violets and lavenders which were mainly used as accent colors.

In combination with subtle luster that seemed to come from yarn combinations and texture, the overall feeling was luxurious.

In patterns, geometric and modern graphic designs far outnumbered florals with small scaled kaleidoscope and Klimt-like mosaic patterns leading. Inspirations came from different epochs — Art Nouveau and Art Deco up to the 1950s and 1960s. Painterly treatments were evident with patterns that looked almost dimensional and layered with a palette knife technique.

The jewel-like golds, rusts and aubergines softened hard-edged Cubistic patterns like Picasso female faces which almost took an ancient Greek sculptured look on panne velvet.

The predominance of opulent color and geometrics made light hearted florals in sophisticated clean pastels against dove gray look fresh and new. The Spanish, who showed as a group, also looked light and lively in decora-



tive fabrics featuring free flowing easy fits and fruit in sunny Costa Rican hues unlike their traditional flamingo colors.

As in apparel, there is no longer one trend dominating home fashions and so there was a surprising diversity of style to appeal to widely different target groups. However, quality was the common thread throughout the show.

The German Fashion Institute (DFI) presented its trend themes in lifestyle groupings emphasizing individual freedom that permits an interplay of tradition, personal originality and new design.

*Decoration* was the theme associated with interior design which reached its high point in England at the turn of the century and incorporated the more traditional Victorian style. English country mansion looks and tapestries.

*Modernite* was symbolized by American lofts where various styles are mixed unconventionally with each other. Stylistic elements from the '30s, '50s and '60s were shown with emphasis on function and practicality. The theme is modern, creative and cool but colorful.

*Mediterrane* was influenced by

the bareness of the Greek countryside and the feeling of sun-drenched emptiness that comes alive with contrasting inspirations from Italy's magnificent palazzi.

Interestingly, visitors were attracted to American exhibitors who featured decorative fabrics and domestics with a distinctively American flavor. The booths were streaming with customers who were picking up on the cleaner, crisper American interpretations of Country English and French as well as American renderings of contemporary patterns. There is no question that the currency exchange makes American goods highly competitive, but it was also style and quality that were important. In fact, some of the European home fashion editors found American fabrics directional.

There were 78 American exhibitors at Heimtextil, up from 65 in 1988. Under the patronage of the U.S. Dept. of Commerce, Office of Textiles, 38 companies were represented in joint stands, up from 27 in 1988. The U.S. sponsored exhibitors credited the Dept. of Commerce with helping to make their showing a success and in some cases helping them find agents in other countries.

— Raye Rudic

## INDUSTRY BRIEFS

### Roger Milliken to Kick Off QuickResponse 89

Roger Milliken, chairman and CEO, Milliken & Co., will deliver the opening keynote address for a two-day show and seminar called QuickResponse 89. The seminar program begins at 8:30 a.m., March 21 and ends with a 3:00 p.m. wrap-up on March 22.

QuickResponse 89 is the first-ever show and seminar devoted exclusively to the business strategies and technology tools required to implement a Quick Response (QR) system. The event

will take place at the Hyatt Regency Hotel at Dallas/Fort Worth Airport, Dallas, TX.

The QuickResponse 89 seminar program features leading industry experts who will examine the business management issues of a QR program as well as the supporting technology tools necessary to implement QR. Real world case histories will also be a major component of the seminar program.

Seminar attendees will also hear the first public presentation of the results of two VICS-sponsored cost/benefit studies: One for retailers conducted by the Arthur Andersen Co., and another for suppliers conducted by Kurt Salmon Associates.

Milliken will deliver the opening keynote address at 8:45 a.m., March 21. His address, "A Push for Partnerships," will examine the need for increased implementation of QR programs and the benefits which can be achieved by retailers, apparel and textile manufacturers and their suppliers.

For more information about QuickResponse 89, contact Automatic Identification Manufacturers, USA, 1326 Freeport Rd., Pittsburgh, PA 15238; 800-338-0206; in PA, 412-963-8588.

### New Center Develops and Demonstrates Technology to Recapture Lost Markets

Operators of a new \$5 million apparel research and demonstration center near Atlanta believe they can help boost the competitiveness of America's apparel industry — using automation, new technology and modern management techniques to recapture markets lost to foreign producers.

Approximately half of the American apparel market now belongs to foreign manufacturers, who benefit from low labor

## NEWS BRIEFS

costs and other advantages. Operators of the new Apparel Manufacturing Technology Center hope to chip away at those advantages by demonstrating and researching robotics, automated material handling, machine vision, computer design stations and other new technologies.

Operated jointly by the Georgia Institute of Technology and Southern College of Technology, the center opened in October 1988 with a pilot-scale demonstration factory set up to manufacture blue jeans using state-of-the-art equipment.

The center's three-pronged mission will be to evaluate and integrate new equipment, develop new technology, and provide hands-on training for students.

Researchers will examine applications of flexible automation systems, computerized information systems and machine-based quality control processes, said Dr. Wayne Tincher, who directs the research efforts. While many individual processes in apparel manufacturing have already been automated, he noted, the center will take a new look at automating the overall manufacturing process.

The center's demonstration plant, located on the campus of Southern College of Technology in Marietta, will allow companies to see modern equipment interfacing with plant processes — and simulate how it might work in their own facility. The technology could make dramatic improvements in productivity, Adams believes, but because of

equipment costs and lack of in-house technical expertise, many companies have been slow to embrace it.

Funding for the new center comes through the U.S. Defense Logistics Agency (DLA), which is responsible for providing the materials needed by the U.S. military. The DLA is concerned that the loss of U.S. apparel manufacturing capacity might limit supplies to U.S. forces in the event of a major mobilization.

The DLA sponsors two other apparel manufacturing centers at Clemson University in South Carolina and at the Fashion Institute of Technology in New York. The Georgia Tech-Southern Tech Center focuses on trouser manufacture; the Clemson Center focuses on shirts, while FIT is looking at tailored garments.

Industry response to the Center has been strong. A 12-member steering committee now advises the center on its research agenda, which focuses on projects with immediate results. More than 450 plants have expressed interest in participating in the center, and hopes are to organize a 100-company coalition which would guide the efforts, share research results, and offer opportunities for testing.

### **Dim Outlook for Soft Goods in 1989 Projected by KSA**

After "six consecutive quarters of consumer disenchantment"

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MARCH 1989

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**Research Center Opens**

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Operated by the Georgia

**K/A NEWS**

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MARCH 1989

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MARCH 1989

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PRODUCTIVITY

## Center eyes automating apparel firms

Can America's apparel industry compete against offshore producers? Can it regain some part of the half of the U.S. market it has lost to these competitors?

Perhaps so, if U.S. companies take advantage of new technologies, including automated materials handling, and manage better.

"We think there is substantial room for productivity improvements using new equipment and management techniques," says John Adams, Georgia Institute of Technology. Adams is program manager for the new Apparel Manufacturing Technology Center near Atlanta, Ga.

Opening last fall with state-of-the-art equipment in a pilot-scale unit making blue jeans, the center receives funds from the U.S. Defense Logistics Agency. It is staffed with personnel from Georgia Tech and Southern College of Technology.

Materials handling and work-in-process (WIP) storage now account for about

80% of production time in U.S. apparel manufacturing, Adams observes. One of the center's projects will involve simulating ways to use production time more efficiently.

Center researchers also will investigate automated materials handling, robotics, low-cost machine vision systems, flexible manufacturing, and computerized data collection. Adams hopes "to break down some of the barriers" to implementing these technologies.

"Long-term," he continues, "our goal is to automate more of the two-dimensional, or flat, sewing steps." Robots and automated handling devices can assist in these sewing procedures more readily than they can in the more complex, three-dimensional type of sewing (attaching sleeves, for example). Roughly 35% of apparel making involves two-dimensional sewing.

By automating the simpler type of sewing, more of a manufacturer's skilled labor force can concentrate on manual, three-dimensional sewing. Second and third shifts—uncommon now—may become more feasible, too, in companies with automation. □

RA S

APRIL 1989

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**APPAREL CENTER  
SET UP FOR SOUTHEAST**

A \$5 million apparel research and demonstration center was recently formed near Atlanta, Ga., to help the Southeast's apparel industry automate and modernize its management. The center is a cooperative ef-



fort of Georgia Institute of Technology, the Southern College of Technology, and the Defense Logistics Agency.

# GEORGIA TECH

RESEARCH COMMUNICATIONS OFFICE

ATLANTA, GEORGIA 30332 (404) 894-3444

May 18, 1989

## MEMORANDUM

TO: Dr. Wayne Tincher  
Mr. John Adams

FROM: John Toon/Ginger Pinholster

SUBJECT: Publicity

In January of 1989, we distributed a news release on the Apparel Manufacturing Technology Center. We thought you would be interested in a summary of the results so far.

To date, articles on the Apparel Center have appeared in at least 12 publications with a total circulation of 3,564,018 readers. These publications include:

America's Textiles International  
Apparel Industry  
Bobbin Magazine  
Computer Daily  
Daily News Record  
Economic & Industrial Development News  
Machine Design  
Modern Materials Handling  
R&D 2000 Update  
Textile Chemist & Colorist  
The Wall Street Journal  
Women's Wear Daily

We appreciate your cooperation and assistance, and hope you will let us know of other projects that might be of interest to the news media. If you would like copies of any of these articles, please give us a call.

We are also interested in whether this publicity been helpful to you. We welcome your assessment of our efforts -- as well as any suggestions on how we can assist you in the future.

cc: Dr. Fred Cook

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Volume 1 Issue 2

June 1989

From the General Manager

GERBERmover Software Release

## Unit Production Goes to College

If you want to know about Unit Production Systems (not just about GERBERmovers specifically) as a method of manufacturing, here's something that might interest you.

**A Seminar** This August the Apparel Manufacturing Technology Center of Georgia Tech is hosting an all-day seminar/workshop on Unit Production System Applications. Scheduled topics include:

- \* Implementing and Operating a Unit Production System
- \* Management Practices for Unit Production Systems
- \* Flexible Manufacturing with UPS
- \* Motivational Techniques for Smooth Transition to UPS

**Experts** Discussions will be led by a panel of professors and actual UPS users. One important note: the seminar is not sponsored by any

manufacturer of UPS. It is part of Georgia Tech's continuing series of seminars on flexible manufacturing methods.

**Data Exchange** The UPS seminar will give you the chance to ask questions and share ideas with other UPS users — people who produce on their systems every day, just like you. It is an excellent opportunity for you to learn more about both the practical and academic side of Unit Production System Applications.

**To Register** The seminar is scheduled for August 3<sup>rd</sup>. You must register by July 14<sup>th</sup> to attend. Naturally, there is a registration fee. For more information about the actual agenda and registration fee contact:

Susan Griffin  
GTRI/Georgia Tech  
Room 215 O'Keefe Building  
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JULY/AUG 1989

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## **United States**

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The Center's mission will be to evaluate and integrate new equipment, develop new technology, and provide hands-on training for

students.

For further information on the Center, contact John Toon at (404) 894-3444.

# Georgia Updates

## "Quick Response: The Right Product at the Right Place at the Right Time"

Quick Response (QR) applies various concepts and technologies to link textile and apparel manufacturers with retailers to shorten the lead time for placing orders, manufacturing goods, and making deliveries.

QR uses bar coding, point-of-sale scanning, just-in-time manufacturing, and electronic data interchange (EDI) which immediately transfers information between retailers and manufacturers. To work, QR requires partnerships between stores, apparel producers, fabric suppliers, and fiber producers to reduce inventories and increase customer service.

It takes about 66 weeks from production of apparel fibers to consumer purchase of clothing at retail. But QR cuts order turnaround time to 21 weeks and reduces from 55 weeks to 10 weeks the time merchan-

dise spends in inventory. The result: elimination of up to \$12 billion annually wasted in the "apparel pipeline," improved cost competitiveness of domestic suppliers, and better inventory productivity and more efficient retail operation.

Retailers appear committed to QR, but domestic manufacturers have been slower to respond and some retailers have begun to force the issue with their suppliers. Companies currently using QR include Milliken, Haggar, Levi-Strauss, K-Mart, and Wal-Mart. Industry observers anticipate that QR will eventually benefit retailers and manufacturers in many product categories.

## Georgia Legislative Update

H.B. 151: Provides for creation of Seed Capital Fund for business development capital to innovative firms. (Signed 4/19/89)

H.B. 215: Provides a framework to facilitate and encourage coordinated, comprehensive statewide planning and development at the local, regional and state levels of government.

Provides for establishment of Governor's Development Council and regional development centers. (Signed 4/18/89)

H.B. 240. Provides for a five-year job tax credit for certain business enterprises that increase employment by 10 or more in counties designated as less developed by the commissioner of community affairs. (Signed 4/10/89)

H.B. 420. Provides for enactment of Aquaculture Development Act, creation of state commission for aquaculture, and study of aquaculture and the potential for development and enhancement of aquaculture in the state. (Signed 3/30/89)

H.B. 568: Provides for the creation of the Governor's Employment and Training Council. (Signed 4/3/89)

—Holly Lawe

# Focus

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Jan 1990

**GTRI**

# Computerizing the garment industry

By JERRY SCHWARTZ

Engineers and computer scientists at two colleges in the Atlanta area say they have harnessed computers to standard industrial sewing machines to produce a larger variety of garments more quickly and

cheaply than conventional clothing factories do.

The industry, which has long trailed others in integrating computers in its factories, is taking seriously the experiments by the

group from Southern College of Technology and Georgia Institute of Technology.

"What those colleges are doing is not a pipe dream," said William O. Mitchell, of the American Apparel

Manufacturing Association, which represents clothing manufacturers. "It is a way of getting things done a lot more quickly and getting improved quality."

Southern Tech and Georgia Tech engineers said that new computerized systems are in use at an Arrow Shirt plant at Buchanan, Ga., and at a number of children's clothing makers including the William Carter Co., of Griffin, Ga., and Health-Tex in Gadsden, Ala.

Such technology is also in use by a blue jeans maker, the Lee Apparel Co., and by the Russell Corp., of Alexander City, Ala.

A tiny, experimental clothing factory capable of making a few dozen pairs of pants a day has been set up on the campus of Southern College of Technology in Marietta, an Atlanta suburb, to demonstrate to clothing makers what might be done even in the small, rural plants that have been the main producers of clothing in the United States.

**T**he Georgia group determined that instead of buying a new machine or retooling existing equipment to do each new sewing job, specialized computer chips could be programmed so that a single machine could be used for several different jobs with only minor mechanical adjustments.

While some industrial sewing machines already come equipped with computer chips, many of these machines are still used for only one task.

The Georgia group has been developing ways to reprogram these chips so that the machines can perform a variety of sewing jobs.

By reprogramming the machines, the engineers have converted an old straight assembly line into a more versatile line with many subassembly stations. Each computerized piece of equipment can work at a number of tasks instead of one.

For example, after finishing enough zippers to supply all the lines at the factory that need them, the machine can be reprogrammed to work on another task instead of sitting idle.

By switching to another task, a machine can help finish other work that otherwise would take longer to perform and slow up the whole assembly line.

In a conventional assembly line, "substantial inventory is tied up with work in progress and the first garment can take days to emerge from the sequential process," said Wayne C. Tincher, professor of textile engineering at Georgia Tech.

But with the more versatile computerized machines, the first garment might show up at the end of the assembly line in 40 minutes, Tincher said.

In the future, the Georgia scientists said, a large assembly line making several kinds of garments could be directed by a single computer system. ■

MONTHLY 169,000

MARCH 1990

CLIPPED BY Bacon's

*3/13*  
**Key Industry Investment.** The Department of Defense will initiate several programs aimed at invigorating critical defense industries and ensuring their survival. During the next five years, DoD could invest approximately \$80 million in research and development and the advancement of manufacturing technology in four vital commercial areas—clothing, optics, food and precision machining.

Funds put into revitalizing or extending the capabilities of those industries, however, will depend on annual defense budgets through fiscal 1996, and programs could be expanded or cut yearly.

The DoD grant programs are designed to encourage joint research that would benefit the entire sector of an industry.

*3/13 CP*

Erosion of the U.S. military industrial base has become an increasing strategic concern for DoD, and officials point out several factors that have contributed to a serious shortfall in U.S. defense manufacturing capability, which would be especially significant if the United States would need to mobilize quickly for war.

A growing dependence on foreign designs and overseas production of military hardware; a decrease in private investment in the domestic defense industry; and an aging, inefficient manufacturing infrastructure are only a few of the factors that have a direct bearing on what analysts say is a serious national security threat.

Projections of severe cuts in defense spending exacerbate the situation by causing defense industries to shift long-term emphasis toward their commercial business. Areas that would be especially affected by a spending slowdown and industrial redirection are continued defense technology-related research and upgrading the processes and machinery to produce defense materiel.

The U.S. optics industry during the 1980s was hard hit by foreign competition, losing almost half its business to Japan and other Asian countries. To counter that, the American Precision Optics Association is creating a Center for Optics Manufacturing at the University of Rochester (N.Y.). Total DoD investments in the project could reach \$35 million during the five-year period. The center is to develop advanced, automated optics manufacturing techniques.

The U.S. high-technology machining industry, specifically those producing precision gears used in a wide range of defense applications, has been plagued by a variety of problems. Most companies manufacturing these gears are small and cannot independently develop state-of-the-art machining techniques. DoD could invest almost \$37 million during the next five years in projects at the Illinois Institute of Technology that would consolidate basic research and development for several companies.

The clothing manufacturing industry, another segment of U.S. industry suffering the effects of foreign competition and outdated manufacturing techniques, will get approximately \$6 million in DoD funds during the next five years to conduct automated production research at Clemson University and the Georgia Institute of Technology.

DoD will also emphasize food processing technology during the next five years—directed at expanding the capability of food companies to produce combat rations. Toward that goal, Rutgers University is to get more than \$3 million in operations and research grants to open a center to develop

technology that would expand food processors' capabilities to shift to combat ration production if the need should arise.

Secretary of Defense Richard B. Cheney has emphasized a growing need for joint projects that would ensure the viability and advancement of key defense production and protect the U.S. industrial base.

**Power-Packed Processor.** Honeywell, Inc. and several subcontractors—General Electric, General Dynamics and the University of Florida—have been selected to develop a miniature signal processor that Honeywell officials say will pack the processing power of ten supercomputers into a 4×6-inch cylinder. The \$9.5 million, 30-month development project for the microprocessor, called the Aladdin, has been funded through the Defense Advanced Research Projects Agency's smart weapons program.

The Aladdin is designed to be used in a variety of applications, ranging from smart munitions to avionics, and can be configured for a number of electronics packaging approaches.

The processor uses high-level language programming, and officials estimate that it will deliver a peak processing power of one billion floating point operations per second.

**MI Hall of Fame.** The Military Intelligence (MI) Corps has established an MI Hall of Fame to honor distinguished soldiers and civilians who have made significant contributions to the field.

The MI Hall of Fame, exhibited at the In-

telligence Center and School, Ft. Huachuca, Ariz., inducted its first honorees in 1988. Thus far, 99 members have been inducted. The 1990 selectees are to be inducted this July.

Membership in the MI Hall of Fame is open to military and civilian personnel of all grades who are no longer on active duty.

Although the selection board convenes once each year, officials said they are continuously seeking worthy candidates. Nomination details are available by contacting the project officer, Capt. Michael Sands. Mail inquiries should be addressed to the Commander, U.S. Army Intelligence Center and School, ATTN: ATSI-MI, Ft. Huachuca, Ariz. 85613-7000. The telephone numbers for nomination information are (602) 533-1181 (commercial) or 821-1181 (AUTOVON).

**Marshall Scholarships Awarded.** Cadets Edward Hoyt and Michael Thorson of the U.S. Military Academy at West Point have been selected to receive Marshall Scholarships that will allow them to continue their studies in England after graduation.

Both cadets are economics majors and are among the 30 U.S. students selected each year under a program enacted by the British Parliament in 1953 to show appreciation to the United States for its assistance during World War II. The scholarship was named in honor of Gen. George C. Marshall, the Army chief of staff during the war who went on to become secretary of state and defense and primary architect of the Marshall Plan for the reconstruction of postwar Europe. **TC**

THE A C H  
MONTHLY 25,000

APRIL 1990

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3/13

**STITCH IN TIME...** Two Georgia colleges are experimenting with computer uses in industrial sewing machine environments. A recent *New York Times* article claims a number of the state's clothing makers are testing the stitching flexibility of computerized systems designed by Southern College of Technology and Georgia Institute of Technology. Early feedback indicates that specialized computer chips can be programmed to allow one machine to perform several different jobs. One clothier claims the new technology might cut labor forces as much as 20 percent in some plants.

80A-40 APPAREL INDUSTRY  
MAGAZINE  
MONTHLY 18,600

MARCH 1990

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3/13  
**Ga. Tech, DLA Offer On-Site Consultation**

The Georgia Institute of  
Technology's Apparel  
Manufacturing Technology

Center (AMTC), part of the Georgia Tech Research Institute (GTRI), has introduced a consulting service for apparel companies.

The service provides individual, on-site assistance to increase the use of advanced manufacturing technologies, productivity engineering and human resource management techniques.

Consultants from GTRI's Economic Development Division will perform a 10-to 15-day study of a company's facilities, helping to identify and justify advanced equipment and systems; analyze operation costs; develop productivity incentive systems; conduct supervisory development and training programs; improve work methods; and provide assistance on government contract bids. Partially funded by the

U.S. Defense Logistics Agency (DLA), companies requesting the service incur only 25%-50% of the total project cost. Any domestic apparel manufacturer is eligible for the program, and all implementation projects will be handled on a case-by-case basis. //

# The Apparel Manufacturing Technology Center:

## A "Clothes-up" View

By SUSAN F. HAWKINS

**B**efore you toss your day's apparel in the hamper this evening, check the labels. There's a better-than-ever chance your garment was made outside the USA—a testament to the unraveling of America's once-thriving apparel manufacturing industry and to its nemesis, pervasive foreign competition.

The steady string of defeated apparel manufacturers also concerned Uncle Sam, who happens to be the nation's biggest apparel buyer. To refashion the future of the industry, the government (specifically the U.S. Defense Logistics Agency) offered funding and applied R&D opportunities for the best proposals from colleges and universities that had apparel and textile technology programs.

Many applied, but only three were chosen. Georgia Tech was one of them. In 1988, the Apparel Manufacturing Technology Center (AMTC) emerged to give an ailing industry solutions and hope.

Georgia Tech's abundance in textile and apparel-related engineering courses was the foot-in-the-door for the bidding process. John Adams, a senior research engineer and group manager for AMTC, credits a darn good reputation in defense-type research and research work in general for the win.

"We are well known to the defense industry and a lot of other government entities," Adams said. "The Defense Logistics Agency knew that if anybody had the propensity and the capability to be

successful, we did. We have a demonstrated track record of being involved with industry. Another winning factor is that we collaborated with Southern Tech, which also has a strong apparel-technology education program. At the facility's dedication, Adams' assessment was echoed by Ray Chiesa, the executive director of contracting for the Defense Logistics Agency (DLA). When he spoke of Tech's selection, Chiesa remarked, "You showed a more aggressive and useful program than did some of the other sites in the country."

Though brimming with expectations and enthusiasm, the true hallmark of the center is its base of alliances. AMTC is a composite of Georgia Tech, the Southern College of Technology (Southern Tech), the DLA, and apparel industry members. These competitors in commerce and education have united to create an esprit de corps essential for thwarting a national crisis.

This approach is not new, but the concept is more widely practiced in

Europe and Japan, where government/industry-supported centers of collaborative research are commonly established for the overall welfare of a particular industry.

The W. Clair Harris Center of Excellence in Apparel and Textile Manufacturing, a new facility on the Southern Tech campus in Marietta, Ga., houses part of the Tech effort. With 20,000 square feet, there's room enough for classrooms, offices, an auditorium, apparel and computer labs, and AMTC's pilot plant, where blue jeans are manufactured.

**I**N CONCERT WITH RESEARCH AND DEVELOPMENT, most of which are performed on campus in Atlanta, Georgia Tech and Southern Tech operate the pilot plant, where the vanguard in apparel manufacturing technology is debugged, deployed and demonstrated. The greater part of the equipment, valued at \$2.5 million, was donated by vendors such as Gerber, Pfaff, Union Special, Brother and Mitsubishi. Southern Tech provides the facility and

its management, and their applications-oriented student base contributes skilled personnel to operate the center, give demonstrations and make modifications in the equipment. Seed funding for AMTC comes from the U.S. Defense Logistics Agency. Of the more than \$5 million the DLA has allocated to the project, \$3 million is dedicated to research and development.

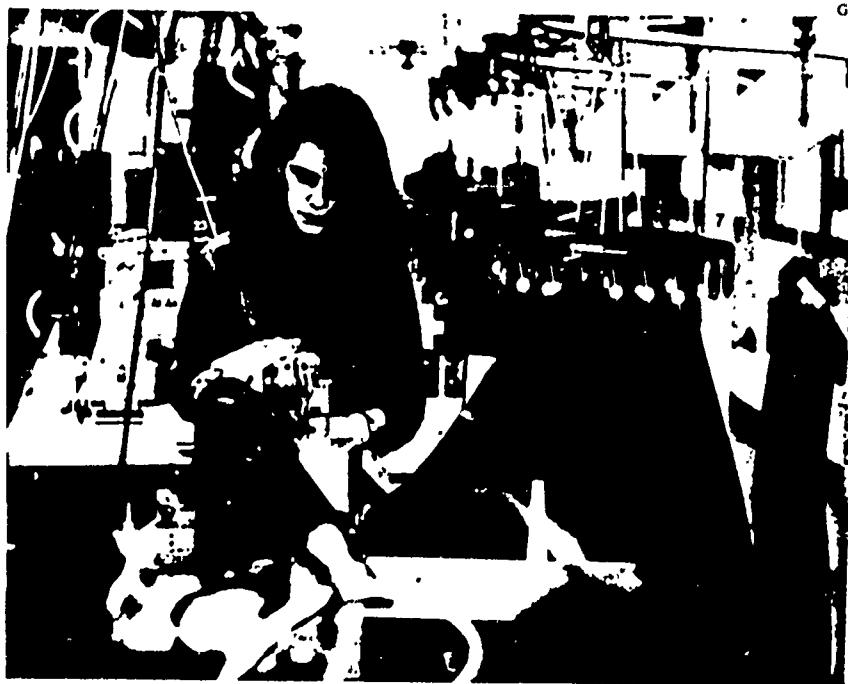
"They're the free world's largest apparel producer," explained Adams of the DLA's commitment to the U.S. apparel industry. "They purchase over \$1 billion worth of clothing a year."

The government's reliance on domestic resources to supply clothing needs for defense services was in jeopardy because, according to Adams, "the apparel industry is probably the hardest hit of all American industries by foreign competition."

A disturbing statistic bears out that assessment. The apparel industry accounts for \$20 billion of the U.S. trade deficit, second only to the automobile industry.

Multiple factors have made our apparel industry a near-casualty in the global market. First and foremost is the high content of labor required to manufacture apparel.

"There's about 50 percent of the production cost of a garment tied up in labor alone," said Adams. "That in itself makes it easier for low-wage producers, like some of the countries in the Pacific basin, to compete effectively with American manufacturers. Over the past 10 years we've probably lost 50 percent of the manufacturing base in apparel production. That statistic alone concerned the DLA."



AMTC's pilot plant is at the forefront of apparel manufacturing technology.

A second concern is that, 15 years ago, the amount of equipment available from apparel producers was limited. That's no longer true.

But over time technological development was slow, as well as a third and very significant factor in the industry's decline. Technically, the apparel industry has been very slow to automate systems. System information management systems and slow to use computers in manufacturing and management. "It's curious for an industry to have such a quick response time to a business problem," Adams says. "I really want to explore that," he says. Adams except to say that the industry is somewhat unique in that, for the most part, it's composed of small manufacturers. A typical apparel plant is a small business.

Innovations in new techniques and equipment are slow, moderately risky investments. New technologies were tried out by the big apparel manufacturers first, and that's changed.

"Now AMTC is pushing the envelope and the industry is seeing they need to be progressive."

He has led AMTC in the more than 20 pilot projects nationwide that have been set up as coalition members. These companies are the primary recipients of the technologies developed by AMTC. They coordinate and participate in research projects and have access to AMTC laboratories for their own training and development activities. Members can attend educational seminars and workshops that are presented year round. Publications such as AMTC Quarterly keep members apprised of research progress, new developments and strategies for the future.

The slacks division of Oxford Industries in Monroe, Ga., is a notably active industry member, with participation early enough to be instrumental in initial equipment selection for the plant. Division president Larry Johnson gives a powerful endorsement of AMTC. "I think it's essential to our survival in the apparel industry," he says. Johnson feels the same about his commitment with companies that in the marketplace, are competitors.

Larry Stone, director of manufacturing for the Lovable Co., agreed. "Everybody realizes that the need and the solutions that come from this approach will benefit us individually if it benefits the industry."

"We have the same problems—scheduling problems, manufacturing problems, marketing and delivery problems. It's to our advantage to work together," Stone said. Stone is a member of AMTC's advisory board, comprised of key industry representatives who operate like a

company's board of directors.

The board helped get AMTC on its feet, defined its mission and assisted in equipment selection. Now that the center is up and running, the quarterly board meeting agenda includes the development of pertinent workshops and seminars and prioritizing research. Relevant research is job one, so AMTC researchers compiled a list of 24 research ideas which were then ranked in order of importance by the advisory board. The 14 ideas ultimately submitted to the DIA for funding consideration were based on ranking and availability of expertise.

Most of these ideas have been accepted and are underway. Funding for individual projects varies, with some receiving nearly a half million dollars. Just as valuable to each project is its industry champion—a plant or company that works shoulder to shoulder with the developer of the idea. Along with advice, a project sponsor gives generous monetary contributions. This system expedites the research and takes a lot of the guesswork out of real-world application and implementation.

A prime example is the pairing of Oxford Industries/Slacks Division with the Apparel Manufacturing Architecture project developed by Dr. Sundaresan Jayaraman, who's also an assistant professor in Tech's School of Textile Engineering. "Architecture" usually brings to mind a coherent and solid structure based on a strong foundation with a goal-oriented design strategy. In apparel manufacturing, architecture is actually a framework for the representation and analysis of the enterprise.

Jayaraman's architecture brings computer-aided-manufacturing to the management, control and operation of an apparel enterprise. He sees it as a language through which all the different factions of a company—management, design, manufacturing, marketing and sales—can understand and communicate with one another.

In this three-phase project that began in July 1988, Jayaraman and graduate research assistant Rajeev Malhotra first developed the function model, to be followed by the information model and the dynamics model.

The function and information models represent day-to-day operations, while the dynamics model will allow companies to do "what if" analyses.

The program uses a complex methodology, called IDEF, that was developed by the U.S. Air Force in the 1970s. It stands for ICAM DLFusion, with ICAM representing "integrated computer-aided manufacturing." Virtually every function of an apparel manufacturing enterprise can be explored in astonishing detail through a series of computer screens that

breaks down each one further and further for thorough investigation. It seems almost infinite in scope.

The screens contain varying degrees of information, with some packed to the borders with boxes, arrows, lines and lettering, all to describe the inputs, outputs, mechanisms and constraints for each function.

The experts say this architecture will help manufacturers get a better picture of their overall operations so they can evaluate their current practices and make changes to improve their procedures. It will also define standards for data communications between machines and systems. And, perhaps most useful in the long run, will be the ability to make cost-benefit analyses for more savvy investment decisions.

Among the projects currently in development, Jayaraman's is further along in the stretch from idea to implementation, but several other researchers are not far behind in tailoring a high-tech tomorrow for apparel manufacturers.

Research engineer Charlotte Jacobs-Blecha thinks marker-making can be elevated to a higher level of automation. A marker is a planned layout of pattern pieces on a length of fabric that minimizes fabric waste.

Present techniques include some semblance of a computer-aided-design system, but for the most part an operator lays out the pattern pieces manually with a stylus at the workstation.

Jacobs-Blecha is studying current systems to determine the technical and economic feasibility of making improvements. A survey of vendors and users is the first step on her way to a technical analysis and cost model. Researchers Daniel J. Oruz and Michael J. Kelley are taking steps to treat the human condition in the industry during its transition to a high-tech environment.

Initially, the two are identifying ergonomic problems through observation, anthropometric measurement, and personnel interviews at apparel manufacturing facilities that represent a range of sizes and levels of automation.

From these findings, Oruz and Kelley will devise and test alternatives at these same facilities. Eventually, they'll be able to predict and address ergonomic issues in what's being called "the factory of the future"—AMTC's pilot plant.

The final product will be a training manual and videotape for apparel manufacturing supervisors to acquaint them with typical ergonomics problems, their solutions and the benefits they'll reap from providing an ergonomically sound workplace.

It's in the human arena that AMTC is positioned to be of inestimable value. Right now, the apparel industry has a predominantly gray labor force.

In fact, John Adams said, "One plant I talked to was unsuccessful at attracting any labor people under the age of 32. There are some questions as to why that would be. Why can't they attract somebody right out of high school or college?"

He answers that question by admitting, "The industry itself has an image problem, going back to the 1920s and its image as a sweat-shop operation. Certainly these things hurt your recruiting ability." Adams also blames the perception that apparel industry jobs are low quality, low skill, and low-paying, but he said,

"That's really not the case, because many labor institutions rate apparel jobs as the highest skilled in the country for labor people. In a typical sewing operation it takes four to eight weeks, and sometimes longer, to learn that particular operation and reach 100 percent productivity. In contrast, the automotive industry has many jobs that take just one day's time for a person to be at full capacity."

AMTC intends to turn the not-image-wise, through equipment upgrades, more efficient information management and contemporary promotion of a rejuvenated industry.

In engineering and management positions, AMTC is building on what Georgia Tech has been doing for years—preparing students. In terms of reciprocation, this is a remarkably perfect fit!

Although Tech only offers a textile degree, students can focus on apparel-related coursework as a minor.

AMTC's activities are an attractive draw for engineering students searching for a field of endeavor, which should increase Tech's student base in all areas of the industry. Upon graduation, our students, and Southern Tech's supply AMTC's industry members with fully prepared employees.

"What better method for technology transfer could there be?" Adams asked.

Optimism around the industry and especially among AMTC staffers and supporters, is tangible. AMTC observers think that market loss to foreign competition will soon bottom out.

Georgia Tech's Apparel Manufacturing Technology Center may turn out to be the "stitch just in time" to redress the industry's problems—and America's. □

*Susan Hawkins is a producer and director with TechVideo*

311<sup>3</sup>  
PSD

# Academics Keep Course

*The industry's new abundance of technical centers spurs a national gathering where researchers share information* □ by Jules Abend

**T**he nation's first academic research conference dedicated to apparel manufacturing technology was held recently at Philadelphia College of Textiles and Science (PCT&S).

The event brought together key researchers from schools participating in Defense Logistics Agency (DLA) projects as well as other federal, state and privately funded efforts to make domestic manufacturing more competitive. It was dubbed the "Academic Apparel Research Conference on Advanced Apparel Manufacturing Technology Demonstration."

One of the participants, Henry A. Seesselberg of Fashion Institute of Technology, lauded the academic orientation of the Philadelphia meeting, noting, "Other industries ... support research in academia and elsewhere as a matter of good business investment. The domestic apparel industry has never significantly embraced this idea, however, and has been willing to 'let George do it!'

"George, however, became Hans and Rinaldo and Sven and Hiro," he said. "And they did it quite well, leaving the U.S. apparel maker and machines supplier in a very weak and obsolete position. The fact that this conference is being held heralds, I believe, a change in this direction."

The DLA, which convened the meeting, began funding Advanced Apparel Manufacturing Technology Centers (AAMTCs) in 1987 at Fashion Institute of Technology (FIT), New York; Clemson University, Clemson, S.C.; and Georgia Tech/Southern Tech, Atlanta. North Carolina State University, Raleigh, also received DLA funding for equipment development projects.

The DLA program was created out of concern about the long-term viability of apparel production in the United States in the event of a military mobilization.

An unrelated modernization project,

*"There's a worry that we don't have enough money and effort going into this to have a critical mass of effort that will result in something meaningful coming out."*

— Donald O'Brien, DLA

the Apparel Computer Integrated Manufacturing (A-CIM) Center, was created at the University of Southwestern Louisiana (USL), Lafayette, by the American Apparel Manufacturers Association (AAMA) and the State of Louisiana.

And in 1989, PCT&S formed a consortium of 11 industrial research sponsors under the supervision of Pennsylvania's state-funded Ben Franklin Foundation.

The "elder statesman" among the research organizations, however, is Texile/Clothing Technology Corp., or (TC)<sup>2</sup>. Ten years ago, recognizing the serious challenge from imports—combined with antiquated U.S. manu-

facturing techniques—(TC)<sup>2</sup> was established to pursue technology research. The organization is a group of 15 member companies, organized labor and the Commerce Department.

Each of these research centers is involved in a number of specific projects, many of which overlap each other. The Philadelphia conference was designed to keep the researchers from "reinventing the wheel."

Representatives from all the institutions participated, including: Joe Off, (TC)<sup>2</sup>; Seesselberg, FIT; Chris Jarvis, Clemson; John Adams, Georgia Tech; and Larry Haddock, Southern Tech.

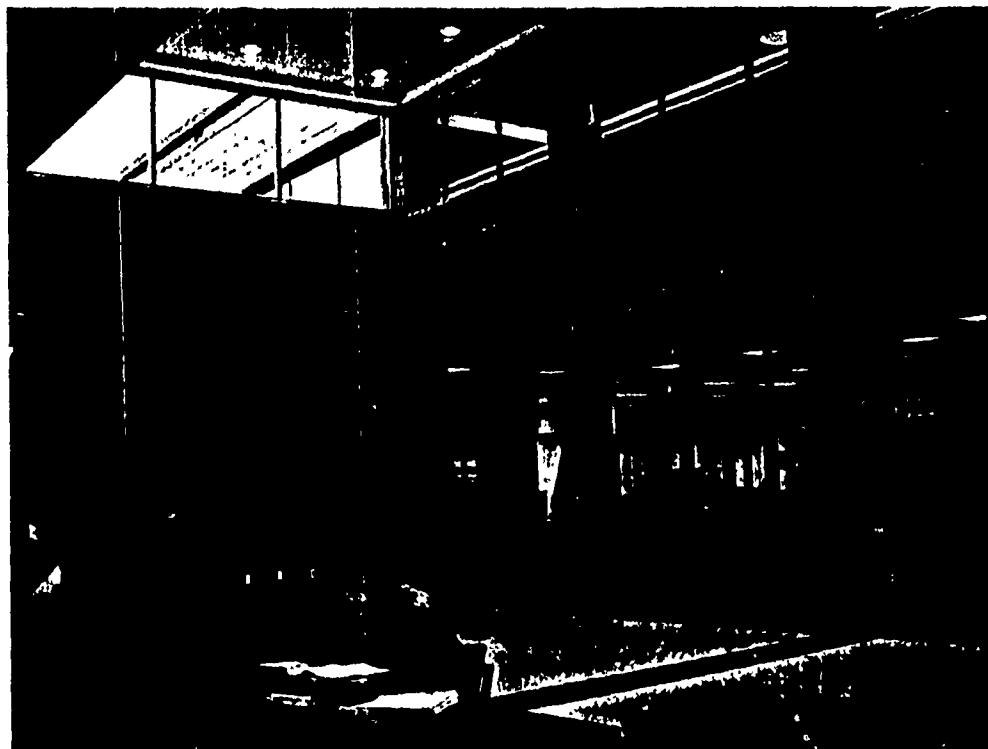
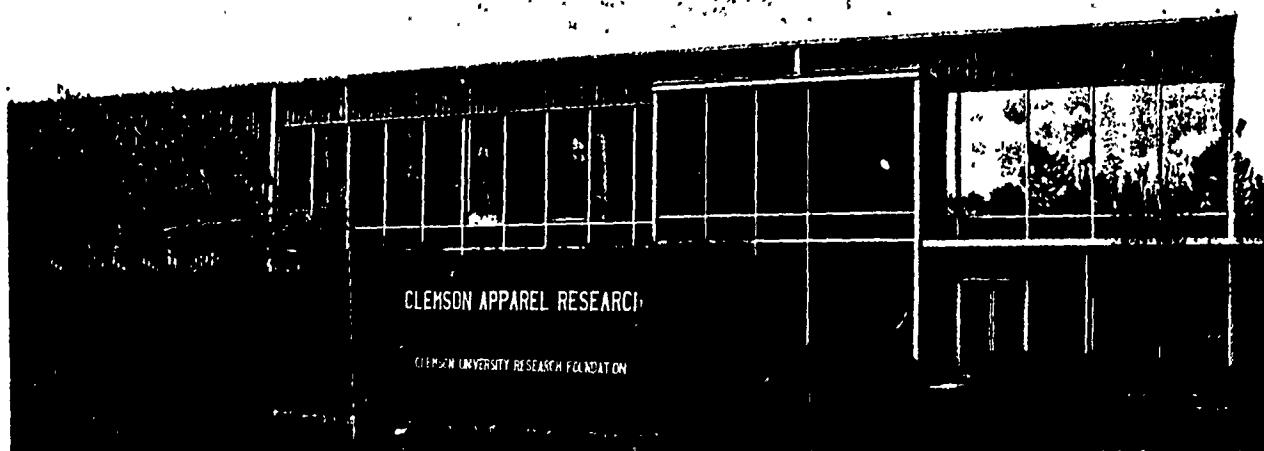
Also participating were: Trevor Little, N.C. State; Lois Delcambre, USL; and Herb Barndt, PCT&S.

The DLA's efforts are designed primarily to support the military, with benefits accruing to civilian manufacturing. And, although future funding is uncertain in the face of the warmer international political climate, optimists believe that federal projects to make U.S. industry stronger will be increased.

One funding realist is Donald O'Brien, chief liaison with the DLA's demonstration centers. O'Brien was one of several participants who called the meeting "historic in terms of getting all of the people together who are doing apparel research."

O'Brien told the group that the meeting was planned to allow researchers to network and to look for collaboration opportunities "so that you can leverage the results to produce an overall larger effect for the benefit of the apparel industry."

"That goal is important," he asserted, "because the amount of money from the DLA, the Department of Com-



Two of the colleges funded by the DLA have dedicated separate facilities for the demonstration centers: Clemson University (above) and Southern Tech (left).

merce, the state of Louisiana and other states supporting apparel research, is very modest.

"There's a worry that we don't have enough money and effort going into this to have a critical mass of effort that will result in something meaningful coming out."

To some, the speed at which the schools set up the demonstration centers and began research is nothing short of amazing. And as the researchers revealed during the first-day "show-and-tell" session, their endeavors are beginning to bear fruit.

High interest in demonstration facilities by industry executives, outside groups and students also was cited by all as beneficial.

## (TC)<sup>2</sup> Highlights Short-Term Projects

**T**hat's not to say that success has been 100%, even among more mature endeavors. As Joe Off of (TC)<sup>2</sup> put it: "We have had our share of failed programs; we've had our flops. But our successes have completely overshadowed them."

Commenting on the pool of talent assembled, Off said, "We at (TC)<sup>2</sup> over the past 10 years traveled a long, lonely research and development road. We are happy to have added emphasis and commitment that the DLA project brings to this apparel technology and

education effort."

Off called the Philadelphia meeting "the beginning of a big involvement between (TC)<sup>2</sup> and the DLA centers."

Off noted that when his organization finally had a home of its own in 1988, it was able to expand the charter from long-term R&D to include a shorter term demonstration/education capability.

Two of (TC)<sup>2</sup>'s shorter term efforts, developed in conjunction with Draper Labs, are: a skip stitch sensor that detects a malformed or skip stitch on any single-needle chainstitch machine running up to 9,000 RPMs, and a fell seamer that automatically forms a seam for denim fabric.

The skip stitch detector is in field



At Clemson's lab, the Army's AG415 short-sleeved shirt is manufactured.

testing and will go to commercialization within the next three months, Off said. The fell seamer already is in commercialization.

"We are also involved with a project using unconventional methods of fabric assembly," he added. "Finished garments cannot be distinguished from present methods ... except for improved quality." The first working machine will be tested at (TC)'s tech center later this year.

Off stressed his willingness to share information, saying, "We have few secrets. And those are only for as long as we need to get a patent processed."

## FIT Center Projects Are 'Down To Earth'

**A**s a result of the DLA-FIT relationship, the school is involved in a variety of projects, including a comparison of cost and production data between a traditional bundle system and unit production system.

Another project involves manufacturing methods for Navy pea coats. Seesselberg said because the specifications for the complex garment are very old, the coat can no longer be made to the

government's standards.

He observed: "Some of the materials specified are no longer manufactured and the few remaining companies attempting to respond to government orders are experiencing high costs and poor quality due to the antiquated methods dictated by the specification requirements, such as basted canvas, one-piece collar and so forth.

"Also, little of the coat can be made with automated machine because of the design," he said.

FIT is creating a new coat design, which, while maintaining the look and function of the previous one, uses new materials and methods.

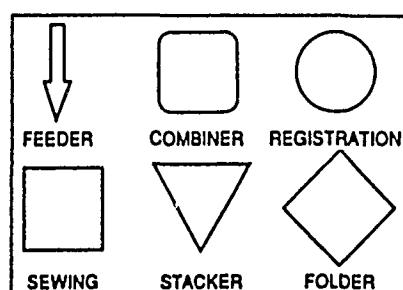
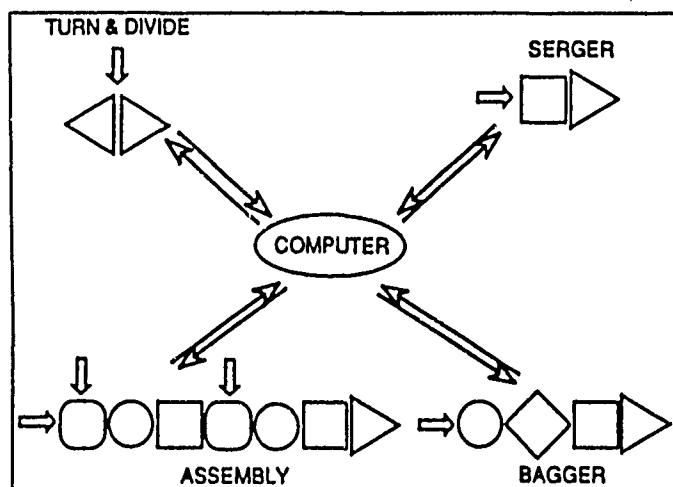
Seesselberg said suitable substitutes for the old thermal body liner and satin sleeve lining were sought

out by a textile student and are being evaluated by the project team.

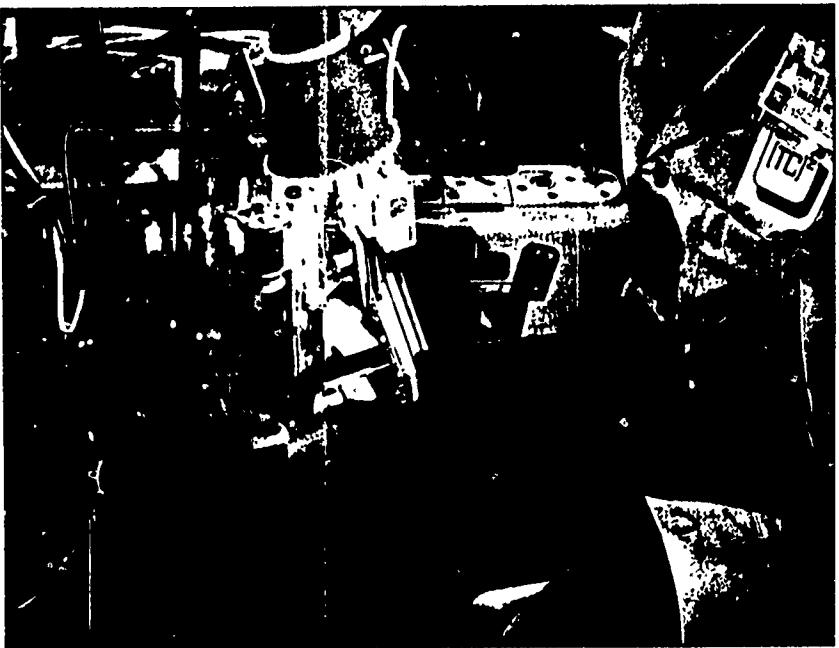
Patterns for a prototype were prepared for fit and function tests and for automated machine assembly analysis. Finally, FIT's advanced technology equipment will be used to assemble the prototype to prove compatibility with the specifications.

## Clemson Center Plays Intermediary Role

**C**hris Jarvis of Clemson offered more evidence that the military,



NC State's research has led to the development of a new system for front pocket assembly, subcontracted to Ark Inc.



(TC)²'s fell seamer, designed at its Raleigh lab, is in commercialization.

while lumbering at times, is becoming flexible.

Clemson is involved in manufacturing the Army's AG415 short-sleeved shirt. In preparation for a visit from the DLA's Major General Charles Henry last May, the project staff, led by Ed Hill, produced a three-page document that proposed improvements in the specifications.

A positive reaction from the general produced such a prompt response that 80% of the suggested revisions had been incorporated by the end of June.

Jarvis believes that proactive stance is one reason the Philadelphia-based Defense Personnel Support Center (see related story, Page 54) has suggested a new intermediary role for the demonstration centers.

The centers would examine military specs for certain garments, make suggested changes, manufacture samples, hold conferences with current contractors and those interested in manufacturing, incorporate the industry reaction, and re-

port back to the DPSC.

Timing is the major roadblock, Jarvis said. "The whole clock is 90 days from start to finish and we haven't quite figured out how we can respond that fast."

Jarvis attributes DLA's positive response to the center's credibility: "We really don't have a vested interest in any of the results of the manufacturing specifications changes."

Jarvis also discussed other Clemson projects and stressed the size of effort associated with the DLA facilities, saying, "Some 70 people are involved. This is not a minor effort. When it was funded, it was the largest research contract the university ever signed. It still retains that distinction."

One service the school offers apparel manufacturers is a computerized spreadsheet to help justify buying a piece of equipment that they've seen in a demonstration center.

"The purpose of the software," Jarvis said, "is, in one neat package, to include all of the different factors that generally don't get considered."

## Georgia R&D Center Application-Oriented

Like the other DLA centers, the Georgia Tech/Southern Tech center performs apparel manufacturing demonstrations. The demo products are utility denim blue jeans and camp shorts.

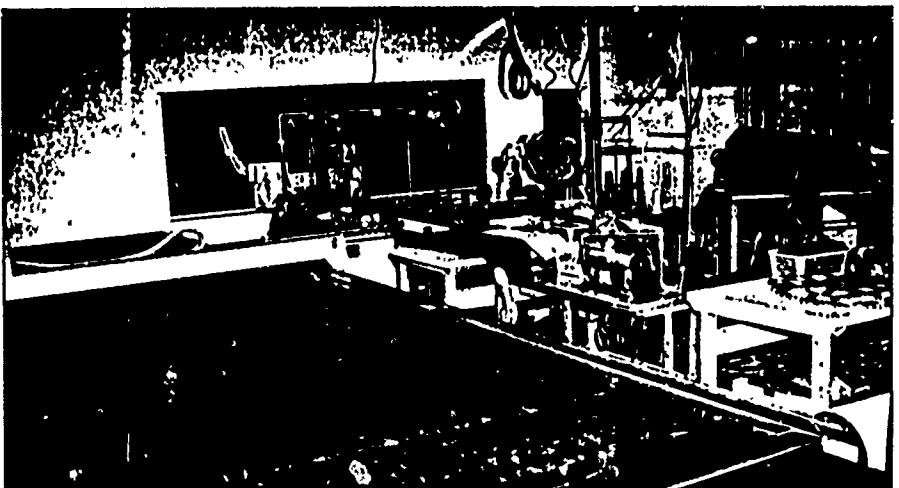
Georgia Tech's Adams said there are about 15 research projects that are "in the mill" and noted that the program is application oriented, "looking for solutions to problems that can be brought to fruition in a couple of years."

Partner Southern Tech is Georgia Tech's main laboratory, with \$2.5 million of equipment. Nearly 50 people are contributing to the DLA activity.

Adams described a software effort at the center involving trouser procurement. The expert system will assist the government in evaluating contracts. The software allows the government to look beyond the dollar amount of the bid, to consider the kind of service a contractor will offer—whether the supplier has a good potential of providing on-time delivery and expected quality.

"Because it is an expert system, it will gather information, continue to grow and become a better tool the more it is used," Adams noted.

The school also is working on a training program to avoid some of the ergonomic problems common to operator workstations. The program is oriented toward carpal tunnel syndrome and



Southern Tech's lab contains \$2.5 million worth of equipment.

(TC)<sup>2</sup>'s "mini-factory" (right), and USL's A-CIM Center (below, right).

also focuses on lighting.

"Our research has shown that most of the lighting in an apparel plant is bright light all around and dim light next to the sewing machines," Adams said. "We have found that situation should be reversed."

In another project, the school is examining how modular manufacturing can be used to produce smaller orders for trousers more efficiently.

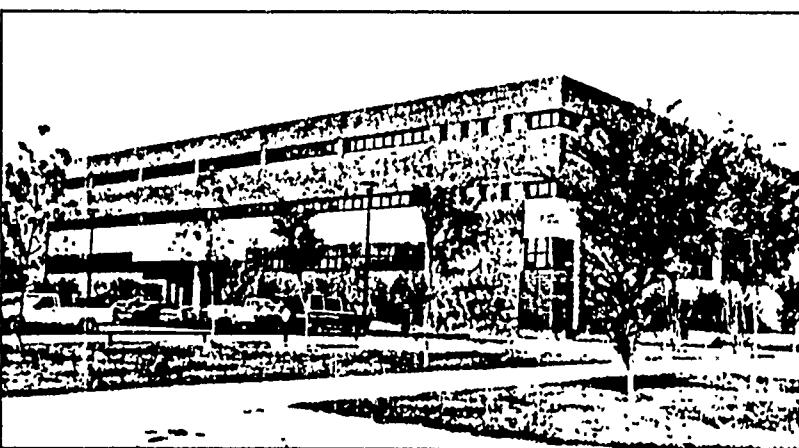
"The questions are really about what we define as a smaller order," Adams said. "In the trouser end of the business, a smaller order is about 1,000 units. And we anticipate that to be even smaller in the future."

Larry Haddock of Southern Tech reported that the center is using a programmable machine for setting and attaching pockets on three different trouser models without having to change any templates.

"In the future," Haddock said, "we plan to download this information for each style to the operator as well as into the microprocessor that controls that machine."

Haddock said that in 1989 the center had more than 3,000 visitors. Many were from industry and education, while others were parents of students and potential students.

"We're really enjoying the ability to show the industry in this light," Haddock said. "And I think that's also important in transferring the technology to as many people as we can interest in our industry."



## NC State Stresses Machinery R&D

Terrell Little of NC State also discussed modular technology development. He said the school, under DLA contract, has developed new machinery for front pocket assembly.

Little explained: "We wanted to be in an area not to exceed 24" x 24". And there wasn't an awful lot of technology to be found. We also wanted to target cycle times that were reasonably short. And," he continued, "we also wanted to combine three parts. There are very few, if any, automated systems in apparel that do that."

Little described the procedures necessary to accomplish the goal, including subcontracting to Ark Inc., "whose conceptual design was very important and impressive and addressed to a large ex-

tent what we wanted to do in terms of building equipment."

The scheme included a turn-and-divide module designed to take face-to-face cut stacks and separate them into rights and lefts for subsequent automated operations; a serger module to automatically feed, serge and stack pocket facings and bearers; an assembly module designed to feed, register, combine and join small parts such as front facing with pocket lining; and a bagger module to feed, register, fold, form the pocket bag, and stack the subassembly.

At this point, Little said the conceptual design works well. One of the major developments is the procedure for feeding pieces to an automated machine. Much to the delight of researchers, a newly developed rod feeder eliminated

the need for the turn-and-divide module.

The serger module is going to Kellwood Co.'s sportswear division, where it will test-produce about 6,000 garments for Mervyn's.

The turn-and-divide module will have a three-month trial in the Defense Personnel Support Center factory cutting room.

Both the assembly and bagger equipment are still at Ark Inc., in the development and design stages, respectively.

## USL Establishes Computer Links

The newest participant in academic apparel research is USL. Lois Delcambre explained that the AAMA-

and state-sponsored A-CIM Center at the school is working on a major project to establish voluntary communications protocols for the apparel industry.

The first project, Delcambre said, has to do with communications protocols for Local Area Networks and Wide Area Networks. It "should be used in manufacturing quite soon."

Another A-CIM project concerns the definition of neutral representation of two-dimensional pattern pieces, which will facilitate the electronic exchange of pattern data among various computer-aided design systems and related equipment.

CIM data transfer standards will allow apparel manufacturers to interconnect diverse equipment from a variety of suppliers. In turn, equipment suppliers will incur lower development costs as interfaces will be defined and available, she said.

## PCT&S Gives Fabric The Eye

PCT&S, host school for the conference, has been researching fabric mechanical properties related to hand, tailorability and other similar attributes.

In the course of its investigations, PCT&S has been weighing the merits of the Kawabata Evaluation System (KES) and the new Australian FAST (Fabric Assessment by Simple Testing) system.

Herb Barndt noted that FAST, which is considerably less expensive than KES, is reported to be "quite satisfactory" based on interim lab results just in from 13 facilities worldwide.

Barndt said the Australian system, which consists of four units, is mechanically very simple. "There are no electric motors, there are no moving parts other than those actually required to apply some pressure or force to the fabric," he said. However, the electronics used in the measurement process are sophisticated and precise, he said.

The PCT&S observations were derived, in part, from results obtained by its apparel manufacturer partners in the state-funded Ben Franklin project.

While the DLA intends for the academic conference to be held annually, Don O'Brien said plans for next year's event have not been made. □

# Motives To Modernize

*DPSC is taking a more active role in DLA schools and other research efforts □ by Diana Burton*

**T**he U.S. Department of Defense (DOD) is one of the few customers that buy nothing but domestically produced apparel. But, just as any customer should expect, the government wants to buy high-quality, competitively priced garments and have them delivered on time.

In order to help domestic apparel contractors meet these expectations, the Clothing and Textile Directorate at DOD's Defense Personnel Support Center (DPSC) in Philadelphia has undertaken several projects to encourage innovation and modernization. These include:

- Establishing a neutral file format for computer pattern grading systems;
- Forming a modernization committee to study government specifications and encourage commercial practices;
- Increasing involvement in the Defense Logistics Agency's (DLA) Advanced Apparel Manufacturing Technology Demonstration (AAMTD) program.

**N**eutral file format. Some time ago DPSC realized that the apparel industry was investing in computerized grading and cutting equipment. DPSC's Directorate of Manufacturing has had such a system for some time, and the various military services have also invested in this equipment. The problem is that the different systems cannot communicate among themselves—hence the need for a neutral format.

The basic guidelines were established: The format must be generic (reflect no brand name), and it must be inexpensive enough so that most companies can afford to upgrade their systems. The Directorate of Clothing and Textiles appealed to the DLA for assistance in solving this problem. The National Institute of Standards and Technology (NIST) was awarded a contract to develop neutral file format software. In cooperation with the American Apparel Manufacturers Association (AAMA), the University of Southwestern Louisiana also is working on the

problem. Major CAD system manufacturers such as Microdynamics also have agreed to participate in the development of the neutral file.

When the neutral file software is completed, it will enable the various systems to communicate with one another. The development phase should be completed this spring.

The government plans eventually to transmit computerized patterns electronically directly to the contractor. However, this goal is long term and requires further research and development into such issues as government verification and legal obligations.

**M**odernization. The DPSC established a modernization committee to analyze current government specifications in light of modern, state-of-the-art manufacturing methods. The committee is chaired by a DPSC representative and composed of members from every military service. The group meets quarterly and selects a generic group of items to study. In the past, the committee researched and concluded studies on dress trousers and dress shirts. Currently it is researching dress slacks and skirts. The committee meets with the appropriate members of industry to address their ideas for modernization.

The most recent modernizing committee meeting was held at the Georgia Institute of Technology's Apparel Demonstration site at Southern College of Technology, Marietta, Ga. The AAMTD program has assisted in the research since the committee's inception.

The committee has recommended that the DOD adopt two paragraphs permitting minor alterations to the government specification and patterns. The changes would accommodate automation.

**T**echnology demonstrations. DPSC also has increased its participation in the AAMTD. Several projects have been sent to the uni-

versities for bids, including: formal AAMTD participation in the modernization committee; a role for universities in reviewing new item specifications and patterns for state-of-the-art production methods; and a research project to determine why government contractors are reluctant to modernize their equipment.

We hope these projects will encourage use of state-of-the-art equipment and methods. The directorate actively encourages military contractors to par-

ticipate in the apparel demonstration sites. Many of the research projects currently underway display an aggressive approach to persistent industry problems that affect both commercial and government manufacturers. Examples include Clemson's research into automated collar point turning and Georgia Tech's architecture of apparel manufacturing. These technologies should be of interest to the government contracting community.

Because of the paragraphs permit-

ting automation in manufacturing operations, there is no longer any impediment to using state-of-the-art methods. The government is open to new ideas that improve the quality and the production rate of military uniforms. The old phrase, "just follow the specifications," is becoming an anachronism within government circles, especially at the directorate.

The DOD is interested in buying commercial products when applicable and in simplifying cumbersome and restrictive specifications. Therefore, the military uniform community must consider modernization to remain competitive. The demonstration sites are a means to evaluate new technology without the expense normally involved, and DPSC supports these efforts.

A study, soon to be underway, will provide the government clothing and textile community with the tools to determine what other efforts are necessary to enhance the use of state-of-the-art technology.

Because the Directorate of Clothing and Textiles interacts daily with the industry, we are an important force. Our attitudes can and do influence the atmosphere in the military contractor market. In the past, we have not fully utilized organizations such as the AAMA; rather, the DPSC has been the only sounding board for all that is perceived to be wrong with government procuring activities.

In the future, we will look to organizations such as the AAMA to assist us in achieving our goal of the best product at the best price, delivered when needed.

Within the next two years, the Directorate of Clothing and Textiles will assume responsibility for preparing specifications. Defense Management Review Decision No. 903 calls for a central office to write procurement technical data for all military services. The military services will provide the requirements; DPSC will determine the type of document to be written and then prepare it. This standardized office will be charged with writing technical data that reflect the apparel industry's current methods. Centralization will enhance the impact of the modernization committee and our current efforts to procure more commercial products. □

*Diana Burton is chief of the Clothing & Textile Section, Technical Operations Division, of the Defense Personnel Support Center.*

## DLA Chief Tours Apparel Center

The director of the U.S. Defense Logistics Agency (DLA), Lieutenant General Charles McCausland (USAF), visited the Apparel Manufacturing Technology Center (AMTC) April 18 for a briefing on recent manufacturing innovations.

He toured the apparel demonstration center at the Southern College of Technology, a partner in the AMTC, where he learned about a computer system that tracks garments as they move through the assembly line. He also watched a demonstration of a system that allows a clothing designer to test patterns using computer graphics.



During a visit to the Apparel Manufacturing Technology Center, DLA Director Lt. Gen. Charles McCausland saw a demonstration of computerized pattern piece layout. (Photo-Joe Schwanz)

Project Director John Adams, of GTRI's Economic Development Division, briefed him on modular manufacturing, programmable sewing machines, and automated material handling.

AMTC, now in its third year, is one of three apparel research facilities funded by the DLA to help improve productivity and competitiveness in the U.S. apparel industry. AMTC focuses on developing more efficient, cost-effective manufacturing processes.

"Apparel manufacturing research is needed to bring down the cost of

see "Apparel," page 3

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## Apparel

(from page 1)

military clothing made in the U.S. so we won't have to buy overseas," Lt. Gen. McCausland said. "Also, in the case of military mobilization, we might need to buy many uniforms very quickly, and we would need a supplier who can respond."

This year, AMTC is conducting 14 research projects in the areas of human factors, automated manufacturing, and management and production systems. The Center also has begun working with industry to implement the results of some of these projects, and has started a new program of problem-solving technical assistance to introduce advanced technology to apparel manufacturers.

## OSHA READIES ERGONOMICS GUIDELINE

By MATTHEW KASTEN

**NEW YORK** — The publication of an Ergonomics Guideline For All Industries by OSHA in the near future will mark a major step by the agency towards suggesting how companies, including apparel manufacturers, can reduce employee health hazards.

A first draft is expected to be published late in July. Industry comments will be sought.



OSHA is leaning heavily on companies that keep poor records, according to Eric Frumkin, ACTWU.

Until now, the agency has gone into industrial plants, and reviewed the OSHA records that companies are required to keep to spot companies that have these problems or hide them by failing to record them.

The guidelines will cover such areas as getting full management support and employee involvement; pinpointing workplace hazards; preventing and controlling

hazards; instituting administrative and medical management controls; and beginning an education program, Washington-based Roger Stephens, OSHA ergonomist, told DNR.

Of particular interest to OSHA among apparel producers are Cumulative Trauma Disorders (CTDs), and one of their prevalent diseases, Carpal Tunnel Syndrome (CTS).

CTDs affect employees whose jobs require highly repetitive motions or who must maintain awkward positions or movements while performing their duties. CTS is identified as a disease of the wrist where the carpal tunnel becomes swollen because of the strains and pressures it undergoes.

Firms that fail to prevent CTDs and/or maintain proper health records are hit with heavy fines, some in six- and seven-figure amounts.

For example, several years ago Union Carbide Corp. was fined \$1.3 million for not keeping a proper OSHA injuries log; 130 days of injuries were missing. This was in addition to OSHA spotting 25 machines that lacked safety guards, for which it fined Union Carbide a separate penalty of \$250,000.

It also found record-keeping violations at other major chemical companies, and fined them large six-figure amounts. Auto manufacturers were fined hundreds of thousands of dollars, and OSHA is currently focusing on the meat-processing industry, where firms have been tagged with penalties for keeping improper OSHA records.

One firm, Iowa Meat Processing, failed to keep proper records, and fines of \$2.3 million were levied against

it. Here, the injuries not reported were of the cumulative trauma disorder type.

Eric Frumkin, Occupational Safety and Health director, Amalgamated Clothing and Textile Workers Union, told DNR that "What's important now is record-keeping. OSHA is leaning heavily on companies that keep poor records of employee injuries."

Checking the "log of injuries," he said, has been getting a lot of OSHA attention in the last three years. Maintaining proper logs of injuries and illnesses is important because it means the companies recognize the importance of the possible problems and are set up to maintain proper workmen's compensation records.

In the apparel industry one of the most recent to get hit is Oshkosh B'Gosh.

According to Department of Labor papers, the Oshkosh, Wis., plant went through a 10-day OSHA inspection in October, after which a list of violations and fines were issued in February 1990. The firm has until March 4, 1991 to correct the violations. Fines total \$3,400.

The company was cited for:

- Causing cumulative trauma stressors to the hands, wrists, arms, neck and back of sewing machine operators.
- Causing cumulative trauma stressors to the neck and back of service workers who lift and transfer garment bundles throughout the plant.
- Causing cumulative trauma stressors to the upper extremities (hands, wrists and arms, and neck and back) of sellers.

- Causing cumulative trauma stressors to the hands and wrists, shoulders and back of examiners and auditors.
- Causing cumulative trauma stressors to the hands and wrists, shoulders, neck and back of hemmers.

In each case, OSHA recommends "feasible methods of abatement for these instances (which) include, but are not limited to (the suggestions)."

CTD and CTS health problems first came to light in the 1920s, Furmin said, but their



Georgia Tech's engineer, Ted Courtney, checks the lighting conditions around workstations in apparel manufacturing environments, as part of Tech's ergonomics research.

prevention was not considered important and workers had to cope with them. "In a sense, they were covered up by employers and doctors."

Currently, men's apparel producers keep more accurate records of injuries than women's wear producers, so it is difficult to say which industry has the greater problem, Frumkin said. However, OSHA data indicates that in the men's and boys' furnishing markets, the rate of injury is seven cases per 1,000 workers. The rate of

CTDs, based on data from all reporting industries, has grown 260 percent from 1985 to 1988.

Frumkin listed the most common CTD problems as carpal tunnel syndrome, tendinitis, bursitis, lower back strain, and strains of the neck.

Changes at workstations that could eliminate or reduce the number of incidents include use of better designed chairs, tables that tilt and better placement of sewing machine treadles, he said.

## NUTMEG BUYS McBRIAR, SWEATER PRODUCER

**TAMPA, Fla. (FNS)** — Nutmeg Industries, Inc., said it has acquired all of the outstanding common stock of McBriar Sportswear, Inc., from McBriar president Bennett Oltman.

Terms of the deal weren't disclosed.

McBriar, a sweater manufacturer based in Philadelphia, had sales of \$9.6 million for the year ended Dec. 31, 1989, including about \$2.7 million in sales to accounts serviced by Nutmeg Mills, for which Nutmeg received a marketing fee.

Nutmeg said Oltman will remain as president of McBriar, which will be run as a wholly owned subsidiary of Nutmeg.

The acquisition is not expected to have a material impact on near-term results but "provides good long-term growth opportunities," Nutmeg said.

Nutmeg produces sports wear bearing the insignias, names, colors, cartoon characters or other symbols of various organizations. Products are sold to department and sporting goods stores under the Nutmeg Mills label.

### AMF PURCHASES CYBRID LTD., BRITISH CAD FIRM

**RICHMOND, Va.** — AMF Sewn Products Systems, Inc., has purchased the British firm, Cybrid Ltd., a developer of computer-aided design systems for the apparel and textile industries.

Bryan Clarke, AMF presi-

dent, said the acquisition gives the company an increased range of products and an expanded emphasis on CAD and computer-integrated manufacturing solutions that are key to Quick Response and Just-In-Time manufacturing.

CTD and CTS health problems first came to light in the 1920s, Furmin said, but their

## Liquid Consistency

Liquids that can change from the consistency of water to that of peanut butter in record time are expected to be used in control devices such as shock absorbers on cars or silencing systems on submarines. Known as electro rheological fluids, these liquids react to changes in electrical fields and can easily be controlled by computer. Researchers at the University of Michigan's Transportation Research Institute are working to develop devices such as rotary couplings and pressure valves, and the hydraulics that help steer aircraft and cars in which the fluids can be used.

## Standard Intelligence

Ford Motor Co., Digital Equipment Corp., Texas Instruments and US West Inc. have agreed to cooperate in a crash effort known as the Initiative for Managing Knowledge Assets whose purpose is to develop a standard of building expert systems. The initiative includes the Carnegie Group Inc., a spinoff of Carnegie Mellon University that is developing computers and software for artificial intelligent systems. The group is hoping to overcome a fundamental problem with expert systems: their inability to share information.

## R&D Funding Down

The National Science Foundation reports that U.S. industry's overall funding of research and development is slowing this year. According to the NSF, projected total spending in 1989 won't even keep pace with inflation, increasing only 2% over last year's \$58.1 billion that the agency estimates U.S. companies spent last year. The NSF surveyed 92 companies, a third of which reported that their R&D budgets were either frozen or declining due to disappointing sales or profits and management emphasis on reducing costs. The 1989 projection of \$61.4 billion is down from an earlier prediction of \$62.2 billion.

## Definitely Fuzzy Logic

Fuzzy logic, which has a big following in Japan, is gaining some ground in the U.S. where it originated, according to *Business Week* magazine. Fuzzy logic is designed to operate around concepts of "maybe" rather than the definite decision of digital logic. Hiroyuki Watanabe, a former fuzzy-logic expert at AT&T Bell Laboratories and currently an assistant professor of computer science at the University of North Carolina at Chapel Hill, has developed a microprocessor-like chip that has an all-digital "architecture" yet can execute fuzzy-logic inferences. Its 680,000 transistors can process 580,000 "if-then" decisions per second. That is 100 times faster than the next best fuzzy-logic chip which is designed in Japan.

## Time For Adjustments

*Insight* magazine reports that a tool called the Acclimator can

be programmed to speed or slow time. It is designed for travelers who frequently cross time zones and routinely adjust their timepieces upon arrival at their destinations. Using the Acclimator, the traveler inputs into his watch the flight time and destination time zone and then turns the device on. If he or she is heading west and gaining time, the watch will operate at a slower than normal rate so, psychologically, the traveler will feel more in sync with the new environment. If heading east, the watch will run faster than normal. Inventor Ross E. Mitchell, a computer systems consultant, said the device will be an attachment to multifunctional watches that run on microprocessors and will probably add \$5 to \$25 to the cost of a watch.

## Smart Skins

New self-monitoring skins and structures, especially for aircraft and buildings, will revolutionize construction techniques in the near future, predicts International Resource Development Inc. Fiber optic smart skins and structures have been researched extensively by the U.S. military but ultimately have important applications in commercial airplanes, spacecraft, urban transit systems and large buildings, according to a study done by the consulting firm. The fiber optic sensors embedded in the skins allow continuous monitoring of parameters such as temperature, deflection, strain, mechanical damage. Manufacturers will be able to monitor, evaluate and correct flaws in composite structures thus eliminating overdesigning; reducing the amount of composites used and reducing the weight while maintaining the structure's integrity; and reducing manufacturing time and costs while improving product quality. Because the smart skins technologies cannot be used with conventional aluminum, steel or other metal or alloy skins or structures, some segments of the metalworking industry are already very alarmed at the impact of the new technologies, the study said.

## 'Where Does It Hurt?'

Two teams of researchers at the Georgia Institute of Technology are approaching the ergonomics of repetitive motion disorders from different perspectives. One team in the Environmental Science and Technology Division recently conducted a study of three apparel manufacturing firms. Researchers analyzed workstations by measuring table height, knee clearance, lighting quality and other characteristics of the environment, and they videotaped workers. The tapes revealed a number of physical "mismatches" between employees and their workstations. These included poor illumination and improperly positioned treadles. The researchers made a few changes in the workplace. They hope to identify factors that encourage postural stress and muscle fatigue and to suggest appropriate prevention tactics, including new technology, engineering redesign and employee training. The other team, at Georgia Tech's Economic Development Laboratory, is working on new machines to automate high-risk tasks within the poultry industry.

--Leslie King

# APPAREL INDUSTRY

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**COVER: Suit by Hickey-Freeman. (Photo courtesy of Hickey-Freeman.)**

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# Embracing Ergonomics

*Three apparel manufacturers share their implementation experiences □ by Gary Fong*

**I**magine a senior vice president of human resources hawking an ergonomic chair to his company's manufacturing managers while making each executive endure the presentation seated in rigid, wooden chairs common in apparel factories.

That is the tactic Pete Ehlinger used to emphasize the importance of operator comfort—or ergonomics, as it has come to be known—at Intercontinental Branded Apparel (IBA).

Ehlinger, IBA's senior vice president of human resources, recently shared his company's ergonomic experiences with more than 75 apparel industry managers at a seminar conducted by the Apparel Manufacturing Technology Center (AMTC). Ehlinger was joined at the seminar by representatives from Levi Strauss & Co., Tennessee Apparel Corp. and the Georgia Institute of Technology. The AMTC is a joint-venture research program between Georgia Tech in Atlanta and Southern Tech in Marietta, Ga.

According to Dan Ortiz, the ergonomics program manager for the Georgia Tech Research Institute (GTRI), a good definition of ergonomics is fitting the task to the individual by adapting the workplace to fit his or her capabilities and psychological and physical needs. If the workstation is very rigid, Ortiz said, it forces the operator to assume stressful postures that can be physically damaging.

Poorly designed operator chairs, for example, promote awkward and stress-

ful postures. Chairs found in apparel facilities often are difficult to adjust and have uncomfortably hard seats and backs, Ortiz said. "[Operators need] a chair that is easily adjustable," he said. "The range of adjustability should accommodate 95% of the work population, so the adjustability should be between 15" to 20"."

Ortiz said that since most operators spend many hours seated at their machines, chairs should have cushioned surfaces for comfort. If operators are not comfortable at their workstations, their performance will be affected. The overall objective of ergonomics is to promote performance by reducing stress, Ortiz said. "And comfort, performance and health basically go hand-in-hand."

**A** hard look at chairs. At Tennessee Apparel, which employs approximately 600 people at three Tennessee facilities, management was committed to thinking ergonomically. The trouser manufacturer, along with two other Southeastern trouser manufacturers, is participating in a two-year ergonomic research program at Georgia Tech. The program, conducted by GTRI, was divided into four phases.

In Phase I, more than 120 operators



Tennessee Apparel said its two test chairs are "like comparing a Volkswagen bug and a Porsche."

were interviewed concerning work-related injuries, musculoskeletal discomfort, training, work schedules, job and workstation design and other job factors. Through these interviews, Ted Courtney, a GTRI research scientist/ergonomist, found high discomfort levels reported for neck, back and hands. According to Courtney, "60% of the workers reported that they lean forward to gain access to their work either through reaching or to get better visual access." Using video workstation evaluation, GTRI found that 40% of the subjects stooped at a 20° angle.

"We looked at chair design and found that most of the chairs were made of wood, were uncushioned and lacked adjustability," said Courtney. Operator-modified chairs also signal ergonomic problems, he said. In fact, GTRI found that "91% of the operators were making modifications, and that told us that this was a high-problem area."

In Phase II, GTRI examined the impact of ergonomic intervention in the workplace. In Tennessee Apparel's

case, researchers focused their attention on operator's chairs.

To begin with, GTRI introduced two chairs to Tennessee Apparel's operators. One chair, common throughout the apparel industry, featured wood surfaces and difficult height and back-rest adjustments. The other chair, designed by the University of Michigan and manufactured by Ajusto, had cushioned surfaces and could easily be adjusted by the operator while he or she remained seated. According to one research participant, comparing the typical chair, with its limited adjustability and hard surfaces, to the ergonomic chair is like comparing a Volkswagen bug and a Porsche.

GTRI focused on permanently seated operators in three plant areas: serging, side-seaming, and facing-and-closing of front pockets. Two groups were formed. One—the control group—used the typical chair, and the other—the experimental group—used the Ajusto chair. While the control group required some direction about the mechanics of its chair, the experimental group had no problems using the Ajusto chair. Both groups received some instruction concerning correct body posture and positioning.

After five weeks, there was a significant improvement in comfort in both the experimental and the control groups. This improvement seemed to be related to the instructions both groups received concerning correct body postures. But, as time passed, operators with Ajusto chairs adjusted their chairs less often.

**L**isten to your employees. Although an ergonomic change might be vital to worker comfort and a company's success, the opinions of the operators should be considered when implementing a change.

"You need to allow the operators options when putting in new equipment," Courtney emphasized. "You don't just make a unilateral technology change. You have to give them time to find out if they like the technology change. If they don't like the change, and if the old equipment is not counter to their best interests, you should allow them to go back to the old equipment if that's what they feel they need."

Ehlinger of Intercontinental Branded Apparel added that "if you do

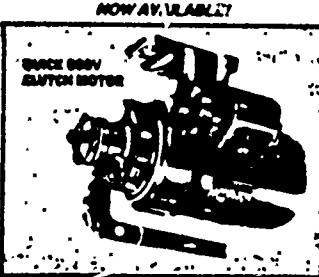
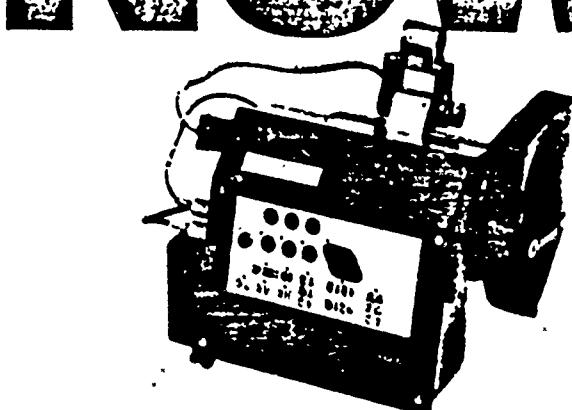
change something and the operator doesn't like it within the first couple hours or first few days, you've probably done something wrong."

According to Diane Smith, an engineer technician for Tennessee Apparel, her company is considering switching from its old chairs. But, while the operators in the experimental group thoroughly enjoyed the Ajusto chair, cost considerations have

forced the company to look at less expensive options. But even so, Smith stressed that Tennessee Apparel will not compromise on operator comfort features such as full adjustability, back support and cushioned surfaces.

The final two phases have yet to be completed. In Phase III of the program, research will move into the high-technology manufacturing environment and focus on potential operator

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problems and operator and workstation interaction. In Phase IV, training materials will be developed to help apparel supervisors and middle and upper management understand and address ergonomic issues in the workplace.

**W**atch for warning signs. Ehlinger, who discussed some of the ergonomic considerations implemented at IBA, pointed out ways to spot ergonomic problems before they get out of hand.

Employers should watch operators and look for abnormal postures, he said. If the operators have to stoop over their work area, work with their wrists at awkward angles or hold their hands in elevated positions for extended periods, then the employer should expect to see cumulative trauma disorders.

Sometimes these problems can be solved simply by raising or lowering a table and adding a slight tilt. For stand-up jobs, Ehlinger said, the work table always should be tilted. "We tilted a table in more than 76 cases and I haven't had a complaint yet," Ehlinger said. Conversely, he has seen "some marvelous success stories," he said.

Simple remedies, such as adding cushions to the edges of work tables to protect the ulnar nerve in the forearm or customizing work surfaces to the operators, are sometimes all that is needed to avoid employee discomfort. But as a rule, he stressed that employers should watch for deviations from neutral postures.

Ehlinger also discovered that most of the operators' chairs at IBA were not adjusted properly. Sometimes, he said, operators adjusted their chairs with whatever was handy. Workers commonly used pillows for back support, and, as he showed the seminar audience, some even used thread cones to position their chairs at the proper height.

Furthermore, he noted that chairs with hard, wooden surfaces simply are not comfortable. "I think every vice president of manufacturing should

have to sit on the same kind of chair the operator has to sit on," Ehlinger said. "And that goes for the vice president of finance as well."

Ehlinger also cited a problem with the chair manufacturers themselves. "Every manufacturer of chairs calls their chair an ergonomic chair," he said. "There is no definition of an ergonomic chair."

Ehlinger emphasized that companies interested in purchasing ergonomic chairs should do extensive research and evaluate many different models. "Don't just compare your supplier's ergonomic chair with your old chair," he said. "Run a comparison test involving about 10 or 12 chairs from several

**U**se common sense. At Levi Strauss & Co.'s Blue Ridge, Ga., facility, plant manager Olin Dunn introduced many common-sense modifications to the work force.

In the past, Levi's used the old-style workstation chairs. "These were not really the best thing for our people," Dunn said. Levi's old chairs, like Tennessee Apparel's old chairs, were hard and lacked adjustability. With help from Art Hill, Levi's ergonomics engineering manager, Dunn evaluated many ergonomic chairs and eventually decided to switch to fully adjustable, cushioned chairs from the Hon Co. that feature a swivel motion. After experimenting with the chairs on various operations at the Blue Ridge facility, the company adopted the new chairs at all Levi's facilities.

"I personally got some of the most sincere thank-you's that I've ever heard on the sewing floor when I introduced the new ergonomic chairs to the operators," Dunn beamed. "The compliments literally came on the

first day. [The chairs] made a world of difference. The chair purchase showed our employees a commitment from management. They realized that we cared."

At the Blue Ridge facility, Levi Strauss also implemented changes to lessen the amount of forceful exertion placed upon operators. Many of the workstations forced operators to twist excessively and slouch, sit or stand in awkward positions. Those stations were re-evaluated and modified to promote better postures.

The company also worked with vendors to improve the design of specific workstations.

"What we used to look for when purchasing equipment from vendors was the price, whether it would provide the productivity that we needed and whether it could give us the quality we needed for that piece of equipment," Hill said. "Well, I've added a fourth requirement. Is the equipment comfortable for the people that are going to have to use it?"

In workstation modification, Dunn

*"I think every vice president of manufacturing should have to sit on the same kind of chair the operator has to sit on. And that goes for the vice president of finance as well."*

— Pete Ehlinger, Intercontinental Branded Apparel

different chair suppliers."

But no matter what chair is selected, the position of the treadle must be addressed. "Most treadles are too close to the front of the machine," he said. "When the treadle is too close, the operator must move the chair back away from the machine in order to operate the unit." In that position, the operator must assume an awkward leg posture, Ehlinger said. Furthermore, operators must lean forward at an extreme angle in order to work, thus reaping no benefits from the chair's lumbar support capabilities.

Seated operators also should have footrests to alleviate pressure placed upon their thighs. Also, all items underneath the work table, such as power switches and control boxes, should be positioned so that the operator is not forced to work around them.

Generally, Ehlinger is pleased with IBA's chair purchase. "I think we are going to see some productivity increases," Ehlinger said, "and I think in the long run, we will see reductions [in disorders]."

said, "There are a lot of little steps that make the difference. Sometimes we are not smart enough to do it right the first time. We sometimes have to come back and do it again, and maybe again, and still maybe again."

Since adopting the new chairs, Levi Strauss has noticed a change in its injury and complaint rate. "We've had our chairs in for about three years, and I'd say we are in a period of [injury] containment," Hill said. "Before the chairs, we were in a period of escalation."

But, although the chairs have made a difference, Hill stressed that a simple chair change is not the answer to a company's ergonomic problems. "Chairs have a tendency to be just part of the solution. Just because you have adjustable chairs doesn't mean the operator is seated properly at the workstation. You've got to go beyond the chairs and educate your employees about good posture. You can't just buy good chairs and expect results."

**W**hy implement ergonomics? The seminar speakers emphasized the importance of implementing an ergonomics program for both the safety and well-being of the industry's workforce and for the protection of the industry itself. The consensus among

related illnesses increases, knowledge among the workers also will increase. And as the workers gain more knowledge, reported injuries will rise.

Ehlinger said that due to heightened awareness, companies implementing ergonomics programs sometimes experience more reported injuries. "People that didn't want to report a problem before are now going to report it. People that had a problem and didn't think it was serious are now going to want to cover themselves. When implementing an ergonomics program, sometimes as much as a third of your employees will report cases."

While the American apparel industry continues to emphasize the technological advances which will make it more competitive in the world market, manufacturers also must address the human resources side of the business. The companies that invest in the health of their workers today will reap benefits in both productivity and quality tomorrow. □

*"Chairs have a tendency to be just part of the solution. You can't just buy good chairs and expect results."*

— Art Hill, Levi Strauss & Co.

the speakers was that the apparel industry's ergonomics problems are much larger than originally perceived. One reason was inaccurate injury and illness recordkeeping.

Through operator interviews, GTRI found that "there might be a greater incidence of injuries than what was being recorded," said Courtney.

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## BACK TO SCHOOL: STUDENT LAB MAKES CLOTHES, EDUCATES INDUSTRY

By LINDA LONGO  
Fashion/Features Editor

WHEN THE DEPT. of Defense wanted to implement some innovative technology, they knocked on the doors of the Fashion Institute of Technology (F.I.T.). It's not that they suddenly wanted designer uniforms for the cadets or even a fashion show for the next officer's club luncheon — Uncle Sam had his eye on boosting the apparel industry from within.

Nearly three years ago, the Defense Logistics Agency, a division of the Department of Defense in charge of procuring clothing for the military, offered a privileged three schools in America the chance to show what one state institution can do for one's country, or at least the garment business. Their mission: to demonstrate to the industry what technology and machinery are available, but perhaps not used very often because of perceived cost or production constraints.

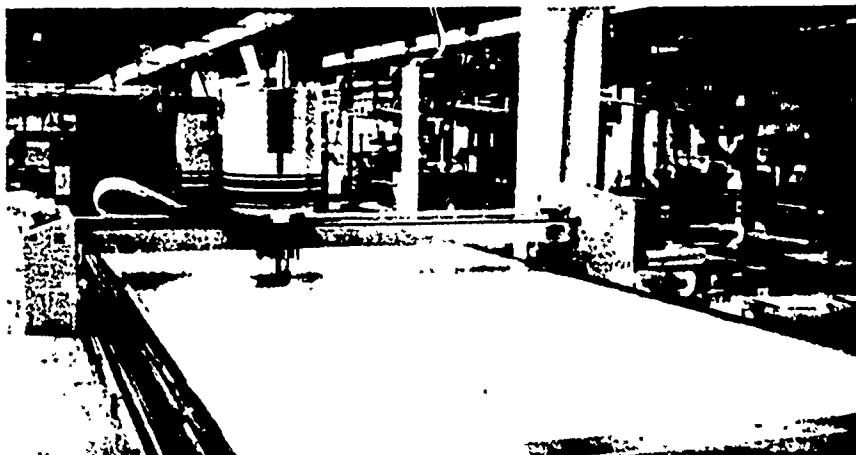
This is no ordinary case of keeping up with the Jones'. The military's interest lies in the spirit of global competition all right, but it is also concerned that if the domestic garment industry falters, the government will have no recourse but to look offshore for garment production.

As expected, the garment guinea pigs are clothes most suitable for military use — chiefly jackets, shirts, and pants — and rightfully so, considering that the laboratory uses clothing patterns dispensed by the government, the only ones that are public domain.

The limited supply of clothing the

students churn out will be bought by the government, though individual projects vary in time and budget, says Henry Seesselberg, director of operations at the Advanced Apparel Manufacturing Technology Department located on the F.I.T. campus. Seesselberg's lab was

berg states, citing, for example, that the average woman of this decade has larger thigh measurements — but a less pronounced rump — than her sea-faring sister did forty-odd years ago. The aesthetics of the uniform will be virtually untouched, though noticeably im-



*The computerized fabric cutter introduces students to the world of automated machinery.*

awarded the tailored men's clothing division; Clemson University, Clemson, S.C., relegated to dress shirts; and Georgia Institute of Technology, Atlanta, Ga., assigned the workwear segment.

The first phase of a redesign of women's military uniforms, which haven't seen the inside of a design studio since 1942, should be completed within six months. According to Seesselberg, the Navy was running up a mammoth alterations bill. "The 1942 design simply does not fit the '90s woman," Seessel-

proved as an estimated 85 sizes will provide the garments with a more fitted shape.

There is also talk of giving the quintessential Navy pea coat a facelift. Some of the material used in the interlinings are no longer available, Seesselberg said, and the construction procedure was complicated as well as costly. "The women's coats have epaulets but the men's style does not," he explained, "so previously they've had to make two separate coats." The F.I.T. lab, using automated machinery, has been able to

# "It's not a museum. We run these machines regularly."

crank out one economical unisex coat with a two-style option: epaulets that attach and detach with the aid of a pin clip.

Though the government welcomes these cost-saving improvements, the garments themselves are not the point. The military is in hearty enough financial shape not to rely solely on students for its clothing, however it is banking on technology.

Government funding has allowed F.I.T. to host a laboratory that simulates a workshop complete with working examples of unit production systems, featuring a conveyor system with individual assembly, computerized cutting, semi-automatic and fully-automatic sewing work stations for all facets of garment assembly, and plans for a modular manufacturing system, designed for maximum efficiency while under the guidance of cross-trained operators.

The entire arrangement will enable up-and-coming members of the apparel industry to be well-versed in the most advanced manufacturing equipment available, and to apply that knowledge to our domestic facilities. In fact, members of the industry are invited to come into the lab and test out the new equipment to see if it would be a feasible addition to their shops before they go through the expense of ordering it from the manufacturer.

All the equipment — an estimated \$1.5 million worth — is on a renewable yearly loan, an arrangement that is not only cost effective but also allows the machine manufacturers to update the models on display. Machinery can come and go without all the paperwork and complications that accompany full ownership. "It's not a museum here," Seesselberg said, "We run these machines regularly."

F.I.T. students involved in the apparel production management programs demonstrate the equipment and perform time studies — manual methods versus automated — to gain a firsthand knowledge of the strengths and weaknesses of each and how to determine which would work best in a given shop's set-up. After all, automation might spell salvation to one particular company yet damnation to another.

Though none of the students' work in the lab — with the exception of the time studies — are part of the F.I.T. curricu-

lum, the same group of interested students are invited to act as troubleshooters for domestic companies that tried to implement these almost exclusively imported machinery into their plants and have met with some sort of difficulty. More often than not, the problem lies not in mechanical failure but in purchasing automated machin-

laboratory was permitted to add women's wear to its roster of activities.

Seesselberg also believes the lab's clean, orderly set-up helps dispel the "terrible sweat shop image" that has dogged this facet of the garment industry. In fact, he recalls one visitor remarking "It doesn't look like anybody is working in here," as Seesselberg led



*The unit production system in place at the Advanced Apparel Technology Laboratory.*

ery that does not fill enough of the shop's needs to make it a productive alternative. The students brainstorm reasons for the difficulty as well as workable solutions.

"We are trying to get the students involved in this program so that they will become a part of it, the program's director said. "People entering all facets of the apparel industry — designers, merchandisers, everybody — must realize that the factory is no longer isolated from the rest of the business: it's now part of the chain. Each person in every step of the process has to know what is going on behind him as well as in front of him. It's become like the hardgoods market."

It is Seesselberg's hope that the program will eventually be weaned away from military purse strings and exist as an accredited program funded by the school. "We are most appreciative of the military's help in starting this lab, but we realize that this kind of funding can't go on forever," he said.

The program is relatively an infant — having only reached the planning board stage a mere two and a half years ago — but it has made great strides already. In addition to the two year extension recently granted by the government, the

him on a tour of the lab. The comment is further proof that the old perception still holds fast, despite the many shops Seesselberg has seen that sport similar impeccable work environments. He is hoping the attractiveness of his facility will make this area of the business more enticing to graduating seniors.

Reviving student interest in the technology of garment making through this automated apparel laboratory is just one step toward the military's and Seesselberg's shared goal of increasing the power of domestic shops. According to Seesselberg, 95 per cent of the lab's machines feature applications or the founding technology that originated in America long ago: The all-American sewing machine now sporting an electronic memory courtesy of Japan and other task-specific machines that had their start in America. "We just gave up on the technology," Seesselberg surmised, citing that current market conditions have made the domestic industry especially investment-wary. "I don't see American equipment manufacturers" reentering the competition "until the industry gets healthy again." And when that happens, we'll have several schools of talent ready to take the helm.

— Linda Longo

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**Polymers That  
Conduct Electricity**

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# Auto Apparel

A Georgia Tech research project in apparel manufacturing using advanced technology

Written by Mark H. Johnson  
Photos by Joe Schreyer

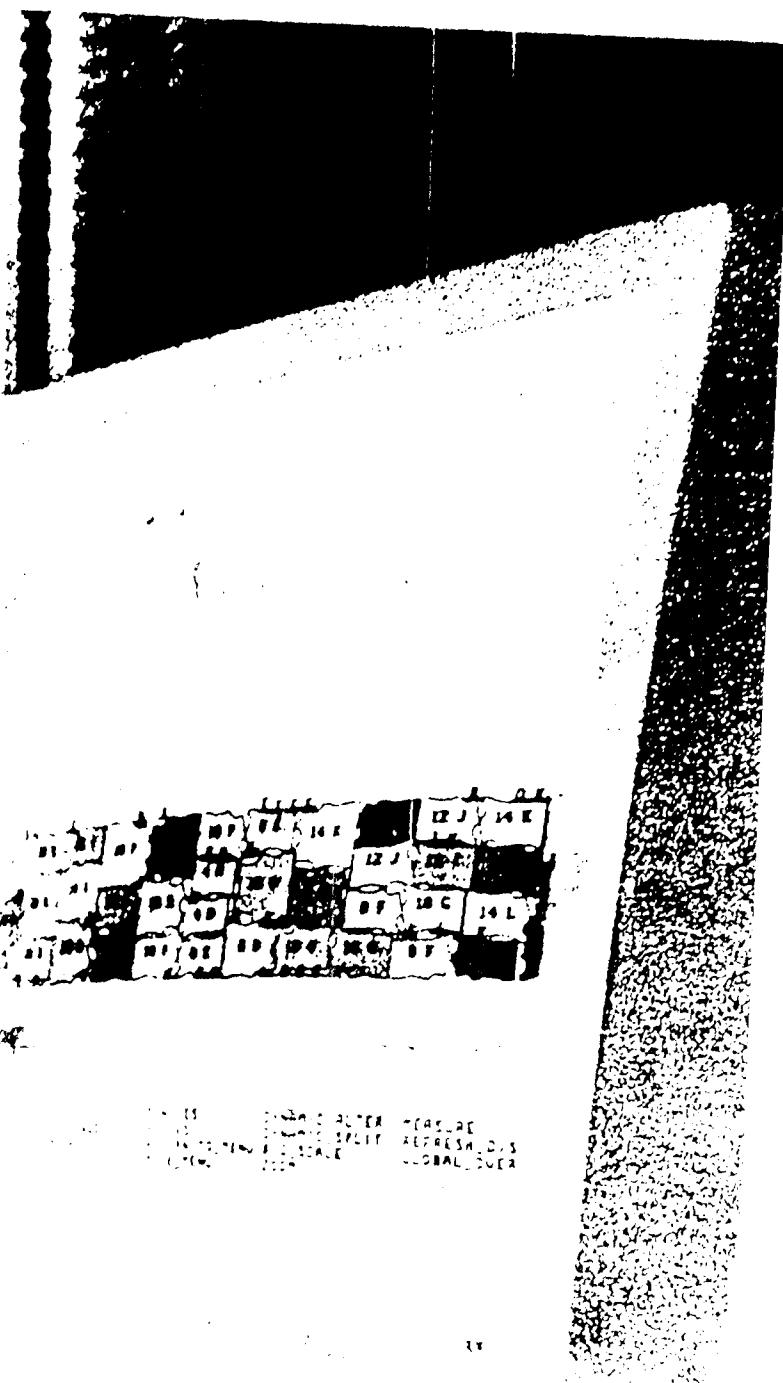
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### Advanced technology could allow apparel firms to reduce production costs and compensate for a shrinking labor pool

been a small, low-technology operation, with nearly half its operating costs tied up in the salaries of employees. For some years, though, the apparel industry also has been "graying," as younger members of the work force look increasingly for jobs in other industries or the non-manufacturing sector.

These problems, though seemingly divergent, can benefit from a common solution: advanced technology. Advocates of this view believe that apparel firms—large and small—could realize major advantages by adopting automated processing systems and computer-integrated manufacturing (CIM) resources. Not only could they reduce production costs and compensate for their shrinking labor pool, but they also could exploit an inherent advantage over foreign competitors—their ability to respond quickly and flexibly to the changing needs of fashion-conscious consumers.

Despite the promise of these benefits, apparel makers have been reluctant to innovate technologically. Many managers fail to see how automation and computer information systems might help their companies in the short term, or they have concluded that their work forces could not adapt to the complexity of these systems. Others have been frightened by the cost of initial investments, while some of the companies adventurous enough to experiment with automation or CIM report less than satisfactory experiences. Sales promises outstripped performance, systems could not be easily serviced locally, or the equipment needed to make necessary improvements could not be adapted to a plant's operating environment.

Though aware of these problems, procurement authorities in the U.S. government are still convinced that advanced technology is a must for its apparel suppliers. Officials in the Defense Logistics Agency (DLA), the world's largest buyer of clothing, fear that without a strong and diverse apparel-manufacturing infrastructure in the United States, the government could face increasing difficulties filling its basic garment needs, particularly in a time of national emergency. For this reason, DLA decided to play an active role in helping apparel companies absorb automation and CIM technology. Three years ago, the agency awarded \$5 million to each of three U.S. research institutions, and gave them the task of developing and demonstrating advanced apparel-manufacturing technologies.

One center was established at Georgia Tech, and two others located at Clemson University and the Fashion Institute of New York. During the three-year period that the initial contract with DLA has run, each center has emphasized the use of advanced technology in the production of a different item of clothing. While Clemson is primarily involved with shirt-making and the Fashion Institute with tailored clothing, Georgia Tech's main concern has been trousers. Tech's principal aim is to improve and demonstrate technology for processes that make military trousers. However, program director John Adams says that these activities also can apply to the production of civilian trousers.

### Industry-university participation

The Georgia Tech Apparel Manufacturing Technology Center (AMTC) has attracted broad participation, not only at the university but outside it as well. From within, the Georgia Tech Research Institute (GTRI) is providing general management for the center, while the research program is directed at the School of Textile Engineering. Research project participants come from GTRI and several of Tech's engineering schools. The demonstration of advanced apparel technologies is taking place at the Southern College of Technology, an institution near Atlanta with a state-of-the-art pilot manufacturing plant (*See sidebar on page 6*).

The center also has established a coalition of apparel industry companies, whose approximately 230 members receive information about advanced apparel technologies through workshops, technical publications, and research reports. The AMTC's advisory board has representatives from industry, who have helped guide the development of the center's programs. Some companies are even making their plants available for field tests in AMTC research projects.

The center's research agenda reflects the priorities of its federal sponsor as well as the needs expressed by industrial coalition members. Fifteen DLA-sponsored research projects are now underway, with total funding of \$3.4 million. As these studies mature, they are being tested at the Southern Tech demonstration center and will be made available to the industry. Projects fall into three main categories: information systems, better utilization of human resources, and automated manufacturing technologies. The following sections describe the highlights of some of these projects.



### Better information systems

Information is critical to the success of any factory. In apparel companies, neither computers nor automated systems can be used properly until management determines if these innovations will work in their plants. The only way to make such a decision—short of investing in expensive new equipment and hoping for the best—is to simulate a plant operation and see how well it performs with a given configuration of computers and automated processes.

For such a simulation to be accurate, it must model the complex processes that make up an apparel operation—from design to production to distribution. Sundaresan Jayaraman, an assistant professor of textile engineering, is building an architecture of a generic apparel manufacturing operation. In developing this architecture, he used a methodology known as IDEF which was originated by the Air Force in the 1970s as an aid in defining the requirements for integrated computer manufacturing systems in a complex plant operation. Through IDEF, a series of diagrams are used to depict the relationships of

the various functions of an apparel company. The diagrams are organized hierarchically—that is, the user can go from one level to another looking at functional and organizational elements in varying degrees of detail.

You don't want to start implementing computers without thinking about where they are best suited to go, Jayaraman says. We need to know exactly what is happening in the apparel enterprise.

This project began in July 1988 with the assistance of Oxford Slacks, an apparel manufacturer in Monroe, Georgia. Oxford Slacks served as the model for a generic apparel manufacturing plant. Jayaraman and his graduate student assistant, Rajeev Malhotra, gathered information by interviewing managers at Oxford Slacks and defining the functions of each department. In the first stage of the study, they developed a function model, a hierarchical representation of all the functions being carried out at Oxford Slacks down to the lowest level of detail.

Continued next page

*The manufacturing pilot plant at the Southern College of Technology is demonstrating an automated bundle-handling system for moving trousers through a series of workstations. Here, technician Howard Pettigrew works at one of the facility's sewing workstations.*

## A Pilot Plant For Testing New Technology

**N**ew technologies may look promising in the laboratory, but how will they work on the factory floor? For answers to this question, the Apparel Manufacturing Technology Center (AMTC) is looking to its pilot manufacturing plant. This facility is part of a demonstration center at the Southern College of Technology in Marietta, fifteen miles north of Atlanta. The 20,000-square-foot center was built in 1988 with a \$1.7 million grant from the State of Georgia and is operated by Southern Tech's Apparel and Textile Engineering Technology Department.

The building includes classrooms, offices, a lecture hall, laboratories for fabric testing and computer-aided design, and the automated manufacturing plant. This factory operation has been equipped with state-of-the-art machinery acquired on loan from apparel manufacturing equipment suppliers. It is being used by the AMTC to produce denim trousers.

The demonstration center not only will help AMTC researchers to hone new concepts in advanced apparel manufacturing technology, but it also will give engineers and managers from private industry an opportunity to see innovation in action. Through this exposure, the AMTC hopes that the apparel industry—traditionally resistant to technological change—will develop a better understanding of automation and computer management systems.

Already, demonstrations of automation and computer management systems are being held regularly at the center in conjunction with technical seminars for apparel industry representatives. These events have been well attended, in large part because so much of the apparel industry is located within a several-hundred-mile radius of Atlanta.

The next step was to create an "information model," a representation of all the information needed to complete each of these functions. These two models describe the structure of an apparel company as it is. The "dynamics model," which Jayaraman and Malhotra have nearly finished, allows management to do a variety of "what-if" simulations of an entire apparel manufacturing plant to see what benefits and costs various innovations might create.

Jayaraman thinks this architecture offers several major benefits. First, the organization can get a better understanding of how its enterprise actually works. Second, the architecture allows managers at various levels of a company to communicate with one another in the same language. Third, it becomes easier for a company to undertake accurate cost-benefit analyses before making major investments in new equipment. Finally, the architecture is defining standards for transmitting information between the various "islands of automation" that

Director Larry Haddock sees a benefit in the demonstration center beyond the technology developed there—the knowledge it provides to Southern Tech students who work at the manufacturing facility.

"The center's almost ideal as a training or teaching environment because you've got students working with the very latest systems," Haddock says. "We think that student involvement is a major portion of the transfer of technology into the industry."

The demonstration center is equipped with a computer-integrated manufacturing system that uses electronic data interchange to demonstrate quick response to changing product needs. In addition, the center has sophisticated instrumentation for testing the quality and strength of yarns and filaments as well as a computer-aided design and fabric-marking center.

The manufacturing facility itself has an automated cutting machine as well as a variety of automated sewing machines. In one corner of the demonstration factory, new methods of modular manufacturing are being tested.

"The students have been very enthusiastic," Haddock says, "and this demonstration center has been an exceptional opportunity for them. The average graduate from our department will get eight to 10 job offers."

*Further information about the demonstration center is available from Mr. Larry Haddock, Apparel and Textile Engineering Technology Department, Southern College of Technology, 1100 South Marietta Parkway, Marietta, Georgia 30060-2896 (Telephone: 404/528-7272).*

populate advanced apparel-manufacturing plants. Commonly accepted standards will be necessary for the machinery sold by different vendors to be compatible. Without these standards, proper design of computer-integrated manufacturing systems won't be possible.

In the next year, Jayaraman hopes to learn more about the architecture's benefits and shortcomings by having "two or three" apparel companies use it in field tests.

Jayaraman's project isn't the only effort at the AMTC to develop simulation tools. In another study, Jude Sommerfeld, a professor of chemical engineering, has adapted a longstanding commercial software product to the needs of the apparel industry.

This software, marketed as the General Purpose System Simulator (GPSS), has been used for many years by engineers for simulations of discrete-event-sequence operations. However, until Sommerfeld's project, no one had adapted it to apparel manufacturing.

The first step in this project was to construct a GPSS model of an actual apparel plant. Sommerfeld chose an Alabama company that manufactures 40,000 pairs of utility trousers a week and has 250-300 workstations. After validating the model on this specific plant, he designed a "high-tech" model based on the automated trouser-assembly operation at Southern Tech's demonstration center, with its many workstations and cutting-and-sewing operations.

"In the high-tech model we have the capability to handle random behavior derived from human factors," Sommerfeld says. "We have built in the normal distribution to represent processing times for the various operations to represent different worker capabilities."

Thus, the model can predict the effects of different rates of absenteeism on production or the impact of new trainees on productivity. It also can be used to explore the effects of new equipment installations.

The value of such a tool was seen when Sommerfeld's research group simulated the effect of different equipment purchases on plant productivity. Some of these changes, he says, "didn't do a bit of good at all. We got no increase in production." Without this simulation

*Ergonomics specialists are suggesting ways to redesign apparel plants so they are less physically stressful to workers.*



tool, Sommerfeld adds, a company would have to buy new equipment to determine if a promising innovation worked.

Sundaresan Jayaraman is leading another study aimed at improving the quality of information in the apparel industry. In this project, he is developing a knowledge-based framework aimed at helping the Defense Logistics Agency make more informed decisions in procuring apparel products from private contractors. Until recently, DLA's criteria for making purchasing decisions have been relatively limited, the agency used pricing information while confirming that the lowest bidder was in the apparel-manufacturing business. This approach failed to account for other information that shows whether the low bidder can deliver the desired quality, by the specified date.

"Our idea was to develop an expert system—or knowledge-based framework—that can be used by federal procurement officials," Jayaraman says. "A system that will assist them in better evaluating the bids. If there are two bidders and one of them is going to charge you 10 cents more but the evaluation tells you the guy can meet your quality and quantity requirements and deliver on time—it's worthwhile to pay the extra 10 cents."

This computer system must embody the knowledge of an expert procurement official, who knows the right questions to ask and the significance of different answers that are received. Jayaraman's research group acquired this "expertise" through a survey of the U.S. apparel industry.

The responses of apparel manufacturers showed that, besides price, four factors should be considered in evaluating contract bids: quality-control procedures, production capability, financial stability, and the company's history of on-time delivery.

The Tech researchers have developed a hierarchical list of questions for a procurement expert system to ask. The kinds of answers that the computer receives at one level of an interview determine its follow-up questions.

This knowledge-based approach also can be used by the apparel industry. Often, apparel manufacturers subcontract with other companies to fill large orders, and they need a tool to ensure that quality and delivery schedules won't suffer.

**An apparel plant "architecture" could help a company decide where computers would work best in their operation**

Continued next page

### Automation technologies

As the apparel industry has adopted automation, quality control has become more difficult to ensure. Wayne Tincher, a professor of textile engineering and the AMTC's director of research, describes the perceptual problems that occur when automated systems replace human workers.

"If a worker is there when something goes wrong, he or she is likely to see the problem and take corrective action," Tincher says. "But if a machine is there and something goes

unrecognizable to the computer vision system.

For this reason, quality control has become the central focus of the AMTC's effort to improve automated manufacturing technology. In one project, a research group from Tech's School of Textile Engineering and GTRI is developing a system that automatically inspects fabric parts for defects in color and cutting. In operation, the inspection machine would take a stack of apparel pieces and run them under a machine vision system to determine if all the cuts were properly made and the fabric color were acceptable. The pieces then would be restacked in such a way that they could be fed easily into an automated sewing workstation for product assembly.

Another project is aimed at automating in-process quality control for sewing operations. One of the most common mistakes in apparel assembly is leaving a "raw edge"—that is, having a single edge of fabric showing when it should have been folded and sewn into place.

"We think that a device could be put into the sewing machine that would detect whether or not it's sewing one layer of fabric or two," says Tincher.

Detection of these defects might be done through sound cues. Tech researchers are using sophisticated data-collection systems to

characterize the auditory signature of a standard stitch and one that is a deviation from the norm. The group hopes to operate this inspection device next year at the Southern Tech demonstration center.

Some innovations would not involve full automation, but rather would feature a human using a computer. The use of such a computer-aiding approach appears promising in the fabric marker-making stage of apparel manufacturing. A worker with this task studies the components needed for a given garment, then designs a pattern for cutting them out of a piece of fabric.



**Tech researcher**  
**Charlotte Jacobs-**  
**Blecha, right, is**  
**leading projects that**  
**seek to understand the**  
**potential of computer-**  
**aided marker making,**  
**to improve cut-order**  
**planning, and to**  
**develop analytically**  
**based methods of**  
**modular**  
**manufacturing.**

wrong, it may not know it. The machine may make 100 or 200 defective parts before anyone happens to notice."

Human visual perception is far more sophisticated than that of any machine. However, in industries where components to be inspected have simple, geometric shapes, vision systems have been successful in locating product defects. What makes automated apparel assembly so difficult is that "parts" are normally non-geometric. Moreover, the flexibility of textile fabric makes these pieces hard to handle without distorting their shapes and making them

Success is judged by how little waste is left after the apparel components are taken from these "marked" fabrics. Though experienced human markers can perform this job efficiently, there is evidence that they can reduce waste even further with the assistance of a computer.

At GTRI, industrial engineers are evaluating computer-aiding in marker making. According to project director Charlotte Jacobs-Blecha, the technology appears to be feasible, however, she adds that the mathematics of this problem are so complex that it's doubtful the process could ever be turned over entirely to a computer.

Jane Ammons of the School of Industrial and Systems Engineering (ISyE) is working with Jacobs-Blecha on the first stage of a project to improve a procedure known as "cut-order planning." In this process, apparel managers study the sizes and due dates of their orders, then develop a plan for coordinating the production of these various jobs so that all can get out of the factory on time. Phase one involves the evaluation of software that is now available for cut-order planning. In the next part of the project, the research team from GTRI and ISyE will develop an improved methodology for the procedure and make software available for in-plant testing.

A third project under Jacobs-Blecha's direction is concerned with the use of modular manufacturing in the apparel industry. Instead of sending garments through a lengthy production line, in large bundles, the assembly of single units or subassemblies would be done by small working groups. Operators generally would outnumber workstations in such a production module. They would be cross-trained so that they could switch from one machine to another, as dictated by the needs for smooth work flow.

A number of implementations of modular manufacturing have been set up in industry in efforts to improve productivity. But, according to Jacobs-Blecha, the systems have been developed in trial-and-error fashion. The Georgia Tech group is attempting to study the problem analytically and develop theoretically based methods.

"As far as we know, we're the only people looking at the analytical side of this problem," Jacobs-Blecha says.

Among the questions to be answered in this research are: How many operations should be assigned to a modular manufacturing group? Which operations should be done in this way? How many operators are required? How should

operators be assigned to tasks? What is the best configuration of workstations for ensuring optimal work flow through a module? How should workers in these working groups be paid?

To find answers, the research group is developing a computer model of a generic apparel-assembly plant, known as the "Virtual Manufacturing Enterprise."

"We hope to provide answers to fundamental questions that can be applied universally in the apparel industry," says Jacobs-Blecha.

### ***A 'friendlier' work place***

The design of factories often can undermine human health and comfort. The science of ergonomics was established to study the physical and psychological factors that influence workers so that job conditions can be improved. To this end, GTRI researchers are midway through a two-year study of ergonomic conditions in the apparel industry.

Project leader Dan Ortiz says that the purpose of phase one, completed last fall, was "to get an idea of what the ergonomic stressors were in the conventional sewing manufacturing operation." Ortiz' group surveyed 130 workers at three medium-sized trouser-assembly plants in the Southeast. The researchers looked for impacts on employee health and comfort caused by workstation design, layouts of materials, and environmental factors such as lighting, illumination, noise and factory temperature.

"We found that a number of people have discomfort and pain in the back and shoulder regions," says Ortiz. The causes of these symptoms were plainly evident; many operators habitually lean forward in their chairs, assuming "hunched" postures with neck and back extended, as they carry out repetitive sewing operations. According to Ortiz, the chairs used by these workers cannot be adjusted to the proper height. A large majority of the operators use pillows or cushions that may relieve soreness in their buttocks but only at the expense of back and shoulder comfort.

In phase two, completed in May, Tech researchers tested an ergonomically improved chair in the three trouser-assembly plants. This chair, which is commercially available at a price modestly higher than that of regular chairs, can be raised and lowered to the height desired by the user. Its back rest is also adjustable. "If you lean forward a little bit," Ortiz says, "the back rest will actually follow you to a degree and provide

*Continued next page*

**Quality control has become the focus of the research center's efforts to improve automated manufacturing technology**

**Until now, the center has focused on the problems of trouser-making. In the next few years, it will broaden its activities to cover a variety of apparel products**

low-back support."

Two six-member groups were observed: one used the adjustable chair and the regular chair, while the other used the regular chair after receiving training in proper posture. The researchers then conducted "body map interviews," in which they asked the workers to rate the comfort or discomfort they felt in different body regions on a scale of zero to four. Those who only received posture training noted improvement, but not nearly as much as that reported by the group using the adjustable chair.

The researchers did not measure any significant increase in the workers' productivity when they received posture training or used the more comfortable chair. Ortiz isn't sure why this happened, since intuition would suggest a link between greater productivity and increased comfort. However, he notes that apparel workers are typically paid on a piece-rate basis and, therefore, may force themselves to work at the same pace regardless of working conditions.

The Georgia Tech group is continuing to explore the effect of the adjustable chair on worker productivity as part of a more ambitious study directed by faculty at Clemson University.

In phase three, which recently began, Ortiz' group will be looking at several ergonomic questions. One involves the ability of workers to use computer information systems, and Tech researchers are trying to determine the kinds of graphical displays that help workstation operators to quickly assess their performance. They also will be examining workstation configurations, looking in particular at any benefits that could accrue from using a table that can be tilted forward at various angles or adjusted by height. Another focus of study will be the impact of poor lighting on distorted operator posture.

Poor posture can result in a variety of cumulative trauma disorders—most notably carpal tunnel syndrome, a disease that often afflicts workers whose jobs require repetitive hand motions. This condition results when the median nerve that supplies sensation to the palm of the hand is compressed, causing pain and numbness and eventually a partial atrophy of the muscle just below the thumb.

The last phase of this project will involve development of training material for improving overall ergonomic conditions in apparel plants. This videotape and manual are aimed at supervisors who can make workplaces more sensitive to the needs of humans.

### **Future prospects**

**T**he first three years of the center's contract with DLA expired this summer, and the agency has renewed the agreement for two more years. Besides supporting AMTC's base operation, DLA will fund another \$2.2.5 million in apparel-related research. Center management hopes that, after 1992, the organization can attract enough operating support to sustain itself from state and industrial sources and to continue active research through sponsored contracts.

According to John Adams, the center is evolving in several important ways. First, its focus has become more geographically based than product-specific. When AMTC first opened, the sponsoring agency intended for it to serve trouser manufacturers throughout the country. However, the industrial coalition has attracted most of its members from companies within a 300-mile radius of Atlanta, and many of these firms assemble garments other than trousers. For this reason, the center will refocus its activities to serve a variety of apparel-assembly products.

Second, AMTC will become more industry-oriented than sponsor-oriented in the next phase of its existence. For understandable reasons, emphasis was placed on meeting the terms of its contract with DLA in the first phase. However, the center now will focus more energy toward interacting with the apparel industry and addressing the problems that coalition members raise. To this end, the AMTC will step up the technology diffusion aspect of its mission. The AMTC newsletter, previously published quarterly, will be distributed each month; additional technical tipsheets will be compiled and released; and a minimum of four workshops a year will be conducted. Adams also hopes that Georgia Tech and Southern Tech can incorporate more continuing education offerings for the apparel industry.

"We want the center to act as an information node for the apparel industry," Adams says. "Companies are usually so busy with their products that they tend not to keep up with what their competitors are doing and what industry in general is doing. We'll try to keep up with trends worldwide, especially in Europe and Japan, and disseminate this information concisely and on a regular basis." **RH**

*Further information about the Apparel Manufacturing Technology Center is available from Mr. John Adams, Program Director, Georgia Tech Research Institute, Georgia Institute of Technology, Atlanta, Georgia 30332 (Telephone: 404/894-4138).*

AUGUST 30, 1990

PPED BY Bacon's

## APPAREL TECHNOLOGY

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# F.I.T. GETS READY TO FIT NAVY WOMEN

By EVE TAHMINCIOGLU

**NEW YORK** — The electronic sewing machines, automatic cutter, computerized pattern grader and marker maker, numerical spread fabric cutter, unit production system, automatic side seamer, automatic piped pocket machine, computerized production control and computer-controlled programmable label sewers that are packed into the Fashion Institute of Technology's (FIT) 7,200-square-foot advanced apparel manufacturing facility will no longer be used to demonstrate better ways to produce men's apparel.

Now women's apparel will begin moving through this model production line as FIT launches a program to offer the women's wear industry a look at the equipment and its capabilities. And in early October, the facility will be up and running as an actual plant making women's apparel, producing merchandise to be sold in navy and army stores.

Catalyst for the change over to women's apparel was a government contract to produce a newly designed women's navy uniform, but industry demand to view the technology in action producing women's apparel was the ultimate reason, said Henry Seesselberg, director of operations for the advanced apparel manufacturing technology programs at FIT.

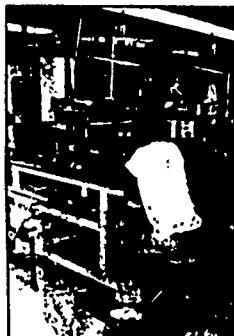
In addition to the military order, the facility will also be used to manufacture civilian clothing, Seesselberg said. Further, it will open to any manufacturer who wants to test and use the center for producing apparel.

While the FIT facility will begin producing salable merchandise under its government contract, research and development is still its main emphasis.

"Our mission is to show the apparel industry that the technology is available now that will allow American manufacturers to compete with low-priced labor. You won't need as many people and you can produce better-quality garments," said the



Henry Seesselberg views the production equipment that will manufacture women's apparel at the Fashion Institute of Technology starting in October.



A sewing machine is shown working on a garment.



A fabric spreading machine is among the equipment in the advanced apparel manufacturing facility.

It will be used to make salable goods.

Seesselberg said prior to receiving the contract "we contacted the Department of Defense and asked if we could convert our operations

to women's wear. New York is not a hot bed for production of men's fashion. We wanted to demonstrate better ways to produce men's wear, so we were making men's trousers and suit coats. But it was tough to get men's wear manufacturers to fly in from Chicago to look at what we had."

The government contract to produce its new uniforms marks the first time the facil-

ity was conducted once a month or every six weeks. "We produced up to 12 dozen trousers at a clip. Some went to the military for inspection and others to the homeless."

Now, the center will design women's uniforms — jackets, skirts and slacks. The facility will run 14 months, with actual production taking place one day each week. While there is no specific number of uniforms the center has been contracted to produce, Seesselberg estimated that "we will turn out an average of 120 garments a week. That's big enough to prove the place will

work, but not enough that we'll compete with anybody. The navy gave us its new looks and the opportunity to make women's uniforms."

The navy uniform has been redesigned to fit the body type of the average woman in the service today. In planning its new uniforms, the navy conducted a special study on sizing. The project included a compilation of the sizing of 3,000 navy women and that was transformed into a representative mannequin which is now at the facility.

"In late September the completed order will go back to the military and be put into its stores."

Government funding for the program started at its inception when the military found there were not enough places to make uniforms in peacetime if it ever had to mobilize, according to Seesselberg. "They decided to open up three demonstration centers: Georgia Tech, Clemson and us. We did tailored clothes."

"The government funds each school. We were funded for three years with an option for two more, and they just picked it up." He said the program gets \$3 1/2 million from the government and FIT funds some of it. In addition, he said the government funds separate research projects, like the redesign of the uniforms.

"The government wants to see a mix of civilian and military. They want to see more and more technology in the apparel industry and that's why we are here."

"The hope is we can convince apparel producers that there are more efficient ways to make them competitive, so they can convince government contractors and save them money."

Seesselberg noted the center has received a lot of help from the International Ladies Garment Workers Union. "They have a handle on what's going on in the women's wear industry and they've been getting us contracts."

"In 1988, the ILGWU asked us in a meeting to talk about See FIT, Page 21

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## F.I.T.

**Continued from Page 20**

how to save the industry and to do something in women's wear and run a model factory to see how this stuff works," Seesselberg said.

"If they don't see it, they tend not to believe," he said about the industry in general. "We find a lack of acceptance to some of the technology. It's almost a put up or shut up situation," he said.

Seesselberg said he believes the first test with salable merchandise will give the project added validity. "Many people want to see if it really works."

SEPTEMBER 9, 1990

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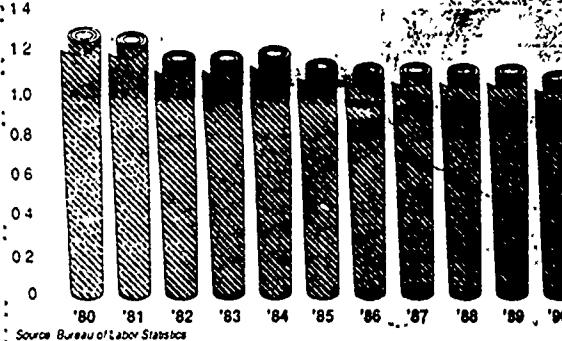
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## All About/Apparel Automation

# Factory Tradition, Fashion Imperative and Foreign Competition

**A Declining Workforce**

Average number of U.S. workers in apparel and related industries, 1980 through July 1990, in millions.



Source: Bureau of Labor Statistics

The New York Times

By JOHN HOLUSHA

**S**OME of the most progressive companies in the American apparel industry are moving from bundles to bits, turning to computer controlled machinery to stem the flow of jobs to low-wage nations. To offset lower costs abroad, American apparel makers aim to improve quality and better keep up with ephemeral fashions. The industry is also experimenting with new ways of organizing production to eliminate the costly pileups of unfinished goods that clutter many factory floors.

"There are three things an apparel manufacturer must provide," said Ed Hill, director of the apparel research program at Clemson University. "The first is quality. Second is timely delivery. And third is cost effectiveness. Since it is hard to compete with labor at 12 cents an hour in Sri Lanka, American companies need to concentrate on No. 1 and No. 2."

## As It Was, and Is Repetitious Tasks, Dusty Bundles

Many apparel companies operate today much the way they did at the turn of the century. Rows of workers apply the same stitches, piece after piece, to bundles of partially finished garments. Then they pass the bundles on to others for the next step.

In other industries, this sort of repetitious handwork has all but given way to automation and robotics. Even the basic textile industry is largely automated.

But adapting machines to garment making has been notoriously difficult. Fabric is thin and floppy, much harder to handle than rigid materials like steel or aluminum. Some operations involve creating what those in the industry call an artificial dimension. "In many cases you are trying to make three-dimensional structures from two-dimensional parts," said Henry A. Seesselberg, director of advanced apparel manufacturing at the Fashion Institute of Technology in New York. A sleeve, for example, begins as a flat piece of cloth and ends up as a tube.

Machines are rapidly growing more capable. Computers are making a big impact,

said William O. Mitchell, director of research and development for Oxford Industries, a big apparel maker. "When they are placed on equipment, they add significantly more flexibility to adapt to changes."

Industry analysts say that Oxford, which produces men's and women's clothing under its own and other labels, has been a leader in automating. Others include Levi Strauss, the maker of blue jeans, and Haggar, best known for slacks.

Clothing with long production runs and few style changes is best for automation. Production of men's dress shirts, for example, has become heavily mechanized due to high volume and fairly standard designs that require fewer than 20 operations.

Men's clothing, in fact, is much easier than women's to mass produce, a fact that resulted in the sort of corporate giants that might afford automation. "Men's suits do not change all that much, so some large companies like Hartmarx have developed," said James Parrott, executive assistant to the president of the International Ladies Garment Workers Union. "But women's clothes are fashion oriented and so diverse that the firms have tended to stay small. The typical outfit averages about 30 people." Small firms can ill afford expensive equipment.

Men's suits are complicated enough, with 180 to 210 operations, so that only parts of these processes have been automated. Women's fashions change so rapidly that automation has been virtually absent.

**Enter the Computer**

## A State-of-the-Art Lab in New York

Some of the most advanced apparel manufacturing devices have been installed in the basement of the Fashion Institute of Technology in New York City. Patterns are converted into digital information in a computer, which calculates the measurements of fabric pieces for different sizes.

Operators using a computer control device known as a mouse can then plot ways to cut shapes from piles of cloth with the least waste. An automated cutting machine nearby allows especially tight spacing of these components, with no need to allow for errors by human cutters.



At the Fashion Institute of Technology, Henry Seesselberg runs the basement research lab, where hangers are replacing bundles.

Then comes the assembly of the clothing, only partly automated. Many of the sewing machines in the F.I.T. shop have been equipped with computer memories, which store patterns for each component. Instead of, depending on their memories, operators simply push buttons to activate the right patterns, feed the material and cut the thread when each piece is finished.

An overhead conveyor carries material on hangers from machine to machine, only stopping at stations where work needs to be performed. The system eliminates bundles and greatly speeds an individual order through the factory. "Work in progress heads toward zero," Mr. Seesselberg said. "You can finish an order in hours rather than weeks. And you don't have to worry about lost bundles."

The demonstration center at F.I.T. is one of three (the others are at Clemson and the Georgia Institute of Technology) that were funded by the Department of Defense, which was concerned that the steady shrinkage of the apparel industry might leave America overly dependent on foreign suppliers (see

box). As the apparel work force has sagged in the last decade, the combined membership of the two major apparel unions has dropped 46 percent from 615,000 to 333,000.

**Labor's View**

## The Emphasis On Saving Jobs

To test new ways of organizing production as well as new machinery, the industry, its textile suppliers and the unions have formed the Textile/Clothing Technology Corporation, or TC Squared, a private research operation in Raleigh, N.C.

Borrowing an approach from the auto industry, TC Squared is encouraging some companies to try team assembly. At the group's demonstration factory, workers assemble all or part of a garment instead of sitting in front of sewing machines, repeating small tasks hour after hour. In most cases, each operator is on foot, performing more

Clemson researchers are studying ways of making the suits without conventional stitching. Ultrasound waves, radio waves and heat can warm man-made fibers until they melt and join together producing a sealed seam. None of these methods are new; in civilian life, they are used for camping equipment, rainwear and umbrellas to blunt the effects of foul weather.

The trick is to adapt them to new uses, especially for the increasingly demanding military applications in which an airtight seal is vital. Stitchless technology could prove to be faster than conventional stitching, allowing suppliers to speed up emergency production in case the threat of chemical warfare becomes a reality.

than one task on each garment. "She might sew a seam, then walk to another machine and put in a button hole and then go to another and put in a belt loop," said Joseph W.A. Off, the TC Squared managing director.

Since garments speed through the system, one at a time, instead of sitting on the floor in bundles, they stay clean. And if a worker makes a mistake, the next person can detect and correct it almost immediately, rather than fishing it from an anonymous bundle days or weeks later.

Responding quickly to changing fashions and retailers' demands can give American factories an advantage over suppliers an ocean away. Typically, Mr. Off said, garments linger unfinished in factories for weeks, then sit in warehouses. "We should be able to get the response time down to one week if the cloth is on hand," he said. "If a store does not have your size, the retailer can promise to have it for you next week."

Unions say they will not resist automation, even if it threatens jobs. "We do not oppose technical innovations," said Mr. Parrot. "This is a very labor-intensive industry and there is always pressure on wages. If we can enhance the productivity of union firms over nonunion ones, then we can enhance wages."

If the future is in F.I.T.'s high-tech basement, the large-volume apparel operations remain in the low-labor-cost rural South. There, a potential obstacle to automation is a work force that is about 80 percent women. Most factories still run only one shift so employees can care for their families. But making expensive machinery pay often requires multiple shifts, with factories operating at night.

Nor is technology totally on the side of American apparel makers in their competition with the third world. A subsidiary of The Limited retail chain uses satellite communications and high-definition television to transmit pictures of the latest designs to factories in southern China. Six weeks later, the copies land in American stores.

# NEW Y ew Jer

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Bellcraft Manufacturing Company  
GA880325  
P.O. Box 610  
Hartwell GA 30643 -  
Mr. Clay F. Bell  
Partner  
(404)376-4731 ext:

Biljo, Inc.  
GA880003  
P.O. Box 609  
Dublin GA 31021 -  
Mr. Dan Coxwell  
Assistant Plant Manager  
(912)272-6935 ext:

Bowdon Manufacturing Company  
GA880025  
127 N. Carroll Street  
Bowdon GA 30108 -  
Ms. Elizabeth A. Plunkett  
Executive Vice President  
(404)258-7242 ext:

Brumby Knitting Mills, Inc.  
GA890660  
PO Box 464  
Young Harris GA 30582 -  
Mr. Dennis L. Plott  
President  
ext:

Buster Brown Apparel  
1100 Peachtree St.

NY880125  
Greene Rd.  
P.O. Box 174  
Greenfield Center NY 12833 -  
Mr. Andrew J. Kebbinsky  
President  
(518)893-2493 ext:

Basset-Walker, Inc.  
VA890042  
P.O. Box 5423  
Martinsville VA 24112 -  
Mr. James M. Caldwell  
Director-Corp. Quality & Prod. Dev.  
(703)632-5601 ext:

Belding Corticelli Thread Co.  
CT900015  
One East Putnam Ave.  
Greenwich CT 06830 -  
Mr. Kenneth Swearingen  
VP Director of International Marketing  
(203)622-5137 ext:

Big Yank - Cowden Company  
KY880005  
P.O. Box 12500  
Lexington KY 40583 -  
Mr. Doug Harris  
VP Planning, Methods  
(606)254-6627 ext:

Bobbin Blenheim Inc.  
SC880021  
P.O. Box 1986  
Columbia SC 29202 -  
Dr. Manuel Gaetan  
President/CEO  
(803)771-7500 ext:

Branson Ultrasonics Corporation  
CT880009  
41 Eagle Road, Commerce Park  
Danbury CT 06810 - 1961  
Mr. James Mengason  
Director of Marketing  
(203)796-0583 ext:

Burlington Denim  
NC880040  
P.O. Box 21207  
Greensboro NC 27420 -  
Ms. Darlene L. Ball  
Manager, Customer Support  
(919)379-2946 ext:

Calvin Manufacturing Inc  
1000 Peachtree St.

Mr. Mike Forrest  
Plant Manager  
(703)646-3116 ext:

Talladega GA 30176 -  
Mr. Bobby D. Nelson  
Plant Manager  
(404)574-2361 ext:

Capital-Mercury Shirt Co.  
AR890020  
P.O. Box 237  
Marshall AR 72650 -  
Mr. Lloyd DePriest  
Dir. of Research and Development  
(501) 448-5999 ext:

Carolina Dress Corporation  
NC880056  
P.O. Box 328  
Hayesville NC 28904 -  
Mr. Walter Fuller  
President  
(704)389-8339 ext:

Carvajal S.A.  
CO900007  
Avenida de Las Americas 40-81  
Bogota, Columbia CO -  
Mr. Alfredo Carvajal S.  
Vicepresidencia  
ext:

Center for Innovative Technology  
VA890044  
1000 East Main St.  
Wytheville VA 24382 -  
Mr. Dan Mills  
Dir. of Economic & Technical Dev.  
ext:

Center for Manufacturing Engineering  
MD890024  
National Institute for  
Standards and Technology  
Gaithersburg MD 20899 -  
Dr. Richard H.F. Jackson  
Deputy Director  
ext:

Charles Gilbert Associates, Inc.  
GA880599  
P.O. Box 70427  
Marietta GA 30007 - 0427  
Mr. Charles Gilbert  
President  
(404)642-1704 ext:

Clark-Schwebel Fiber Glass Corp.  
GA880163  
P.O. Box 1050  
Cleveland GA 30528 -  
Mr. Donald C. Gailey  
Manager  
(404)865-2181 ext:

Clayton Uniform Manufacturers  
MA880008  
1030 University Avenue  
Norwood MA 02062 -  
Mr. Harold Berger  
General Manager  
(617)769-5700 ext:

Clemson Apparel Research  
SC890036  
500 Lebanon Road  
Pendleton SC 29670 - 1957  
Mr. Ed Hill  
Site Director  
(803)646-8454 ext:

Clemson University  
SC880033  
Dept of Computer Science  
Clemson University  
Clemson SC 29631 -  
Dr. Jack Peck  
(803)656-5871 ext:

Coats & Clark, Inc.  
GA880001  
P.O. Box 670  
Toccoa GA 30577 -  
Mr. Paul Couture  
Product Manager  
(404)886-2141 ext:

Coats & Clark, Inc.  
GA880294  
Mill St.  
P.O. Box 352  
Pelham GA 31779 -  
Mr. Robert R. Martin  
Manager  
(912)294-2911 ext:

Cooperman Pants Company, Inc.  
IL880004  
570 Melody Lane  
Highland Park IL 60036 -  
Mr. Tom Cooper

Crown Textile Company  
PA880025  
3 Valley Square #3006  
Blue Bell PA 19422 -  
Mr. Tom Cooper

Crown Textile Company  
PA880095  
3 Valley Square Caller 3006  
Blue Bell PA 19422 -  
Mr. Joseph Cusimano  
Merchandising Dir. of Menswear  
ext:

Dan-Mar Manufacturing, Inc.  
MD890025  
55 New Plant Court  
Dwing Mills MD 21117 -  
Mr. Morris J. Bricken  
Chairman  
(301) 363-6000 ext:

Defense Personnel Support Center - FSL  
PA880085  
2800 South 20th Street  
Philadelphia PA 19101 - 8419  
Ms. Diana Burton  
Chief Clothing & Textile Section  
(215) 737-5657 ext:

Doerun Sportswear, Inc.  
GA880009  
P.O. Box 146  
Doerun GA 31744 -  
Mr. Brady L. Davis  
Co-Owner  
(912) 782-5283 ext:

Dundee Mills, Inc.  
GA890661  
P.O. Drawer E  
Griffin GA 30224 -  
Mr. Troy A. Mays  
V.President & General Mgr. of Mfg.  
ext:

Emsig Manufacturing Corporation  
NY880009  
253 West 35th Street  
New York NY 10001 -  
Mr. Daniel A. Fischler  
Vice President  
(212) 563-5460 ext:

Ernst and Whinney  
GA880603  
225 Peachtree Street  
Atlanta GA 30303 -  
Mr. Steve Hectaky  
Senior Manager  
ext:

Crownluff Manufacturing Co.  
AL880058  
1015 Ross Street  
Heflin AL 36264 -  
Mr. William Wilkinson  
Engineer  
ext:

Dawson Consumer Group  
NC890076  
P.O. Box 659  
Wadesboro NC 28170 -  
Mr. Frank S. Herr  
Vice President Admin.  
(704) 694-3453 ext:

Dewitt Apparel, Inc.  
AL880007  
125 Canada Road  
P.O. Box 538  
Uniontown AL 36786 -  
Mr. Julius D. Shivers  
President  
(205) 628-2141 ext:

Dowling Textile Manufacturing Co.  
GA880010  
615 Macon Road  
P.O. Box 598  
McDonough GA 30253 -  
Mr. Dan Wright  
Executive VP  
(404) 957-3981 ext:

Edmonton Manufacturing Co.  
IN880003  
501 Main Street  
P.O. Box 608  
Rochester IN 46975 -  
Mr. Lewis R. Elin  
President  
(219) 223-4311 ext:

Endo Corp.  
PA890103  
P.O. Box N  
Clarks Summit PA 18411 -  
Mr. Richard M. Pell  
President  
ext:

Solid Garment Manufacturing Co.  
OH880001  
333 Martinei Drive  
P.O. Box 550  
Kent OH 44240 -  
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Production Manager  
513-672-7412 ext:

FL890034  
6650 NW 37th Avenue  
Miami FL 33147 -  
Mr. Thomas J. Chojnacki  
Plant Manager  
ext:

TX880085  
8889 Gateway West  
El Paso TX 79925 -  
Mr. Rudy Morales  
Fabric Quality Control  
(915)593-4227 ext:

Fashion Star, Inc.  
GA880044  
67 Liberty Church Road  
Carrollton GA 30117 -  
Mr. Bill Loftin  
President  
(404)854-4444 ext:

Fashion Star, Inc.  
GA880585  
67 Liberty Church Road  
Carrollton GA 30117 -  
Mr. Andy Cooper  
Vice President Manufacturing  
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Felina Creations  
CA900062  
16542 Arminia St.  
Van Nuys CA 91406 -  
Mr. Massolid Banmariyar  
Plant Manager  
(818)988-9100 ext:

Fiber Industries, Inc.  
SC880028  
P.O. Box 2000  
Florence SC 29501 -  
Mr. Mayo Collier, Jr.  
Quality Superintendent  
ext:

Fountain Apparel, Inc.  
NC880012  
206 W. Blount Street  
Fountain NC 27829 -  
Mr. Charles Ledbetter  
President  
(919)749-2511 ext:

Four Seasons Apparel  
NC880051  
4602 Duncos Drive Suite 110  
Greensboro NC 27410 -  
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Chairman  
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Franklin Sportswear  
GA880046  
Bond Avenue  
P.O. Box 99  
Canon GA 30520 -  
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President  
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Gentex Corporation  
PA880062  
P.O. Box 315  
Carbondale PA 18407 -  
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(717)282-8201 ext:

George Stafford & Sons  
GA880594  
1026 Campbell St.  
Thomasville GA 31799 -  
Mr. Ron Stafford  
President  
(912)228-4337 ext:

Georgia Industries for the Blind  
GA880625  
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Bainbridge GA 31717 -  
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Director  
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Georgia Institute of Technology  
GA880526  
O'Keefe Bldg., Room 215  
CAMPUS MAIL 00000 -  
Mr. William A. Meffert  
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Georgia Institute of Technology  
GA880620  
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CAMPUS MAIL 00000 -  
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CAMPUS MAIL 00000 -  
Dr. Charles Parsons  
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Georgia Power Company  
GA890630  
P.O. Box 4549  
Atlanta GA 30302 -  
Mr. Robert G. Henderson, Jr.  
Sr. Marketing Specialist  
ext:

Gotcha Covered  
TX880052  
8505-C Chancellor Row  
Dallas TX 75247 -  
Mr. Ken Wiley  
President  
(214) 634-2640 ext:

Greenwood Mills  
GA880514  
4805 Lawrenceville Hwy., Suite 116-142  
Lilburn GA 30247 -  
Mr. Jim Miller  
Manager  
ext:

H & H Manufacturing Corporation  
GA880018  
P.O. Box 65  
Statham GA 30666 -  
Mr. Allan Barry  
Plant Manager  
(404) 725-5787 ext:

Haggar Apparel  
TX900108  
6113 Lemmon Avenue  
Dallas TX 75209 -  
Mr. Jud Early  
Vice President - R & D  
ext:

Hampton Industries, Inc.  
NC890077  
P. O. Box 614  
Kinston NC 28502 -  
Mr. Martin Camnitz  
Executive Vice President  
(919) 527-8011 ext:

Hardwick Clothes, Inc.  
TN880078  
Old Tasso Road  
P.O. Box 2310

CAMPUS MAIL 00000 -  
Mr. Russ Cappello  
ext:

Glen Oaks Industries  
TX880072  
8805 Chancellor Row  
Dallas TX 75247 -  
Mr. William B. Swint  
Vice President  
(214) 637-0191 ext:

Granite Wear, Inc.  
NH880002  
P.O. Box 840  
Enfield NH 03748 -  
Mr. Thomas Mangold  
President  
(603) 632-7941 ext:

Grief Companies  
PA890104  
939 Marcon Blvd.  
P.O. Box 9000  
Lehigh Valley PA 18001 - 9000  
Mr. Kermit Miller  
Production Manager  
ext:

H&O Research  
TX880082  
6113 Lemmon Avenue  
Dallas TX 75209 -  
Mr. Jud Early  
Vice President, Research & Development  
(214) 956-0251 ext:

Haggar Apparel Company  
TX880053  
6100 Cedar Springs Road  
Dallas TX 75255 -  
Mr. Jack Smith  
President  
(214) 353-0554 ext:

Hardwick Clothes  
TN880037  
P.O. Box 2310  
Cleveland TN 37320 - 2310  
Mr. William B. Foster  
Chairman  
(615) 476-6534 ext:

Harmony Grove Mills, Inc.  
GA890662  
P.O. Box 359  
Commerce GA 30529 -

ext:

Hartwell Company  
GA880078  
P.O. Box 160  
Hartwell GA 30643 -  
Mr. Tony Haynie  
Vice President of Mfg.  
(404)376-5421 ext:

Hartwell Company  
GA880618  
P.O. Box 160  
Hartwell GA 30643 -  
Mr. David Setcnel  
VP Information Systems  
ext:

Hickey-Freeman  
NY890148  
P.O. Box 200  
Rochester NY 14601 -  
Mr. Eugene A. Clyde  
Mgr. Professional Emoley.  
ext:

Hoechst Celanese Corporation  
NC880071  
P.O. Box 32414  
Charlotte NC 28232 -  
Mr. Joe Vandermaas  
Technical Consultant  
ext:

IMS Manufacturing Company, Inc.  
KY880018  
Cave Mill Road  
P.O. Box 8  
Leitchfield KY 42754 -  
Mr. Ivan Schmierer  
President  
(502)259-3147 ext:

Johnson & Johnson Medical Inc.  
TX900101  
350 Artcraft Rd  
El Paso TX 79912 -  
Mr. J. Gary Drews  
Operations Manager  
(915)581-8734 ext:

Jostens  
SC880027  
P.O. Box 949  
Laurens SC 29360 -  
Mr. Frank Burton  
Production Manager  
(803)682-3263 . ext:

Hartwell Company  
GA880579  
P.O. Box 160  
Hartwell GA 30643 -  
Mr. Bill Goode  
(404)376-5421 ext:

Henry I. Siegal Company  
TN880076  
126 Lexington Street  
Bruceton TN 38317 -  
Mr. Bobby Forbess  
Director of Engineering  
(901)586-2211 ext:

Hickey-Freeman Company  
NY880129  
394 Warren Avenue  
Rochester NY 14618 -  
Mr. Bruno Castagna  
ext:

I.L.G.W.U.  
NY900159  
1710 Broadway  
New York NY 10019 -  
Mr. Walter Mankoff  
Director of Management Engineering  
ext:

Jaymar Ruby, Inc.  
AL880010  
919 West 9th Street  
P.O. Box 1349  
Anniston AL 36201 -  
Mr. Robert L. Plummer  
Vice President Manufacturing  
(205)237-9411 ext:

Johnson & Jonnison Medical Inc.  
TX900102  
350 Artcraft Rd  
El Paso TX 79912 -  
Mr. Michael D. Lewis  
Director Mexico Operations  
(915)581-8734 ext:

Juki America  
GA890655  
2500A Meadowbrook Pkwy  
Duluth GA 30136 -  
Mr. Rob Lankford  
Sales Manager  
ext:

GA880202  
S.O. Drawer 518  
Patterson GA 31557 -  
Mr. Lindsey Dunaway  
General Manager  
(912)647-2031 ext:

Kings Point Industries, Inc.  
NY880002  
P.O. Box 798  
Great Neck NY 11022 -  
Mr. Harold Rosenbaum  
Vice President  
(516)466-8143 ext:

LXE  
GA880500  
303 Research Drive Suite 144  
Norcross GA 30092 -  
Mr. Stuart M. Dver  
Marketing Analyst  
(404)447-4224 ext:

Lectra, Inc.  
GA880598  
844 Livingston Court  
Marietta GA 30067 -  
Mr. Vernon Sisk  
Atlanta Branch Manager  
(404)422-8050 ext:

Lee Company  
KS880005  
9001 W. 67th Street  
Merriam KS 66201 -  
Mr. Phil Freese  
Manager, Technical Support  
(913)374-4000 ext:

Louisiana State University  
LA880021  
School of Human Ecology  
Baton Rouge LA 70803 -  
Dr. Bonnie D. Belleau  
Associate Professor  
(504)388-1535 ext:

Lovable Company  
GA880588  
2121 Peachtree Industrial Blvd.  
Buford GA 30518 -  
Mr. C. Frank Joyce  
(404)945-2171 ext:

MP Basic Four, Inc.  
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MD880021  
1 Kannegiesser Place  
Forest Hill MD 21050 -  
Mr. Warren Hartenstine  
President  
(800)638-2362 ext:

Kupperheimer  
AR880007  
500 W. Trimble  
Berryville AR 72616 -  
Mr. Norm Kyle  
Plant Manager  
(501)423-2210 ext:

Lake Butler Apparel Co.  
FL890032  
P.O. Box 688  
Lake Butler FL 32054 -  
Mr. Joe Stevenson  
Vice-President  
ext:

Lee Company  
KS880004  
P.O. Box 2940  
Merriam KS 66201 -  
Mr. Dennis Zeigler  
Director of Equipment Engineering  
(913)384-4000 ext: 325

Levi Strauss and Company  
TX880071  
900 North Dorothy Drive  
Richardson TX 75081 -  
Mr. James E. Hiegel  
Asst. Director/General Mgr.  
(214)234-2030 ext:

Lovable Company  
GA880505  
2121 Peachtree Industrial Blvd.  
Buford GA 30518 -  
Mr. Larry L. Stone  
Director of Manufacturing  
(404)945-2171 ext:

Lucky Star Industries, Inc.  
MS880015  
Hwy #45 S. P.O. Drawer K  
Baldwyn MS 38824 -  
Mr. L. E. Gibens  
President  
(601)963-2308 ext:

Magaro and Associates, Inc.  
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Mr. David Markovich  
Senior Account Manager  
(404) 321-1022 ext:

Maid Bess Co.  
VA890041  
865 Cleveland Ave.  
Salem VA 24153 -  
Mr. Richard W. Robers  
Executive Vice-President  
ext:

Mark H. Hardin, Inc.  
AL880030  
P.O. Box 1009  
Leeds AL 35094 -  
Mr. Mark H. Hardin  
President  
(205) 699-5124 ext:

Marxman Industries, Inc.  
MS880029  
P.O. Box 829  
Hazlehurst MS 39083 -  
Mr. George M. Biggs  
President  
(601) 894-3111 ext:

Mattel Toys  
CA880021  
5150 Rosecrans Ave. N. S. 11-518-E07  
Hawthorne CA 90250 -  
Ms. Beth Pollack  
Manager  
(213) 978-7121 ext:

Microdynamics, Inc.  
TX880084  
10461 Brockwood Road  
Dallas TX 75238 -  
Mr. Elmer Leslie  
Vice President Operations  
(214) 343-1170 ext:

Milliken  
SC900054  
P.O. Box 164  
Hwy 5 at I-85  
Blacksburg SC 29702 -  
Mr. Ken Owens  
ext:

Milliken and Co.  
SC890040  
Box 1926 - M-196  
Spartanburg SC 29304 --  
Mr. C. C. Clegg

Mr. Jim Meininger  
Sales Representative  
(404) 451-8876 ext:

Maidenform, Inc.  
NJ880016  
154 Avenue E  
Bayonne NJ 07002 -  
Mr. Shane Triano  
ext:

Martin Manufacturing Company  
TN880003  
P.O. Box 350  
Martin TN 38237 -  
Ms. Audrey J. Roberts  
President  
(901) 587-3861 ext:

Master Slack Corporation  
TN880014  
P.O. Box 224  
Bolivar TN 38008 -  
Mr. Harvey Stringer  
President  
(901) 635-9415 ext:

Methods Workshop  
GA890657  
300 River Valley Rd. Suite 100  
Atlanta GA 30328 -  
Mr. John Stern  
President  
(404) 955-6600 ext:

Military Fabrics Corporation  
NJ880022  
2 Putnam Court  
Holmdel NJ 07733 -  
Mr. Richard A. Brusca  
President  
(201) 264-2702 ext:

Milliken & Company  
SC880019  
M-303  
P.O. Box 1926  
Spartanburg SC 29304 -  
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Director of Quick Response  
(803) 573-1982 ext:

Milliken and Company  
SC880026  
P.O. Box 1926-M-133  
Spartanburg SC 29304 -  
Mr. C. C. Clegg

Mount Vernon Mills  
GA880141  
P.O. Box 649  
Alto GA 30510 -  
Mr. Donald R. Henderson  
VP Technical Services  
(404)778-2141 ext:

N G N. Inc.  
PA880065  
630 McKnight Street  
Reading PA 19601 -  
Mr. George P. Viner  
President  
(215)374-1175 ext:

Navy Clothing & Textile Research Fac.  
MA880036  
21 Strathmore Rd.  
Natick MA 01760 - 2490  
Mr. Harry Winer  
Head, Clothing Research Branch  
(508)651-4133 ext:

Nicelson Corporation  
GA880177  
P.O. Box 1979  
Cornelia GA 30531 -  
Mr. Vernon Mintz  
IE Manager  
(404)778-9794 ext:

Okefenokee Dacs. Inc.  
FL900040  
7825 Baymeadows Way #320A  
Jacksonville FL 32256 - 7503  
Mr. Robert C. Novev  
President  
ext:

OshKosh B'Gosh. Inc.  
WI880006  
112 Otter Avenue  
P.O. Box 300  
Oshkosh WI 54901 -  
Mr. Scott Brown  
Mer. Production Planning & Control  
(414)729-1555 ext:

OshKosh B'Gosh, Inc.  
TN890082  
West Lake Avenue  
P.O. Box 280  
Celina TN 38551 -  
Ms. Leslie Petty  
I.E. Mfg. Concept Specialist  
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Oshgosh B'Gosh, Inc.  
KY890029  
PO Box 408  
Columbia KY 42728 -  
Mr. Bobby Morrison  
Corporate Director of Eng. & Research  
ext:

Oxford Industries  
GA880580  
108 Thomoson Street  
Vicalia GA 30474 -  
Mr. Ray Hamilton  
Manager of Research and Development  
(912)537-2190 ext:

Oxford Industries  
GA880611  
P.O. Box 408  
Vidalia GA 30474 -  
Mr. Bill Mitchell  
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Oxford Industries - Lanier Clothes  
GA890658  
191 Victor Street  
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Oxford of Bowman  
GA880363  
P.O. Box 460  
Bowman GA 34624 -  
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Oxford of Monroe  
GA880589  
Cherry Hill Road  
Monroe GA 30655 -  
Mr. Larry Johnson  
(404)267-6501 ext:

Oxford of Monroe  
GA880590  
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Monroe GA 30655 -  
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NY880119  
1407 Broadway  
New York NY 10018 -  
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Parks Manufacturing Company, Inc.  
GA880340  
555 North 1st Street  
P.O. Box 328  
Jesuo GA 31545 -  
Mr. Jim Parks  
President  
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Pendleton Woolen Mills  
OR880003  
218 S.W. Jefferson Street  
P.O. Box 1691  
Portland OR 97207 -  
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Chairman  
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Protexoll Inc.  
IL890040  
77 South Henderson Street  
Galesburg IL 61401 -  
Mr. L. W. Williams  
President CEO  
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Quitman Manufacturing Company  
GA880086  
P.O. Box 29  
Quitman GA 31643 -  
Mr. Bruce Feinderg  
President  
(912) 263-7573 ext:

R. J. Studdard & Son, Inc.  
GA880465  
900 Second Ave.  
P.O. Box 407  
Tennille GA 31089 -  
Mr. Bobby J. Studdard  
President  
(912) 552-3286 ext:

Reece Corporation  
NC880074  
P.O. Box 370  
Stantonsburg NC 27883 -  
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Southeast Regional Director  
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Reitac Manufacturing Company

VA900063  
202 Cleveland Avenue  
P.O. Box 5151  
Martinsville VA 24115 -  
Mr. J. Scott Mostelier  
Director of Apparel Manufacturing  
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Peachtree Industries, Inc.  
NC880033  
Main St.  
P.O. Box 1367  
Andrews NC 28901 -  
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Propper International, Inc.  
MO890025  
539 Tecumseh Drive  
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GA880061  
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Chamblee GA 30341 -  
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Vice President of Sales  
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Gorham Industrial Park  
Gorham ME 04038 -  
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Mr. William W. Hill  
President  
(601) 842-4472 ext:

Reitac Manufacturing Company, Inc.

Mr. Abraham Cooperman  
Vice President, Manufacturing  
(205) 487-4296 ext:

Mr. Wayne Cooperman  
Plant Manager  
(501) 633-2060 ext:

Ricks Ramstar, Inc.  
FL880016  
7800 N. W. 32 Street  
P.O. Box 520646  
Miami FL 33152 -  
Mr. Richard Feiertag  
President  
(305) 592-8767 ext:

Riverside Manufacturing Company  
GA880581  
P.O. Box 460  
Moultrie GA 31776 -  
Mr. John Caldwell  
(912) 985-5210 ext:

Ro-Search, Inc.  
NC890078  
P.O. Box 188  
Waynesville NC 28786 -  
Mr. Horace Auberry  
President  
ext:

Robert Novak and Associates  
PA890105  
191 Haverford Drive  
Laflin PA 18702 -  
Mr. Robert Novak  
Industrial Engineer Consultant  
ext:

Russel Corporation  
AL900123  
Machine R&D  
P.O. Box 272  
Alexander City AL 35010 -  
Mr. Mike Mann  
Development Engineer  
(205) 329-4364 ext:

Russell Corporation  
AL880066  
P.O. Box 272  
Alexander City AL 35010 -  
Mr. Paul Porter  
Manager, Apparel Engineering  
(205) 329-4364 ext:

Sac & Fox Ind Ltd  
OK880005  
2216 SW 74th St  
Oklahoma OK 73159 - 3928  
Mr. James Brarium  
President  
ext:

Sara Lee Knit Products  
NC880069  
P.O. Box 3019  
Winston-Salem NC 27102 -  
Mr. Wayne Foster  
Manager Advanced Process Technology  
(919) 744-2174 ext:

Sara Lee Knit Products  
NC880067  
28, rue Jacques Ibert  
92300 Levallois-Perret FRANCE  
NC -  
Mr. Charles Price  
Vice President Operations  
(011) 331-4759 ext: 1515

Sarrant Acquisition Met. Associates  
VA880028  
4401 Dartmoor Lane  
Alexandria VA 22310 -  
Mr. Robert R. Sarrant  
President  
(703) 922-8606 ext:

Saul Brothers & Company, Inc.  
GA880070  
820 Spring Street, NW  
Atlanta GA 30308 -  
Mr. Carlos E. Bouffier  
General Manager  
(404) 881-1833 ext:

School Apparel, Inc.  
AR880011  
P.O. Box 99  
Star City AR 71667 -  
Mr. John L. Hood  
Plant Manager  
(501) 628-4232 ext:

Sierra Western Apparel  
TX890089  
1109 E Yancell  
El Paso TX 79902 -

Signal Thread Company  
TN880075  
521 Airport Road  
Chattanooga TN 37422 -

Singer Sewing Company  
NJ880017  
P.O. Box 1909  
Edison NJ 08818 - 1909  
Mr. Vincent Vento  
ext:

Slovin Company  
MA880021  
121 Higgins Street  
P.O. Box 198  
Worcester MA 01606 - 0198  
Mr. Saul R. Slovin  
Vice President, Manufacturing  
(508)853-4289 ext:

Southern College of Technology  
GA890707  
1112 Clay Street  
Marietta GA 30060 -  
Dr. Bill Rezak  
ext:

Southern College of Technology  
GA890710  
1112 Clay Street  
Marietta GA 30060 -  
Ms. Carol Ring  
ext:

Stag, Inc.  
PA890106  
5060 N. Pine Street  
Hazleton PA 18201 -  
Mr. Sylvano Tagnani  
President  
ext:

Swan Industries, Ltd.  
MI880006  
77 Hancock Street  
Manistee MI 49660 -  
Mr. John T. Berlin  
President  
(616)723-3531 ext:

Tanner Companies, Inc.  
NC880047  
Oak Springs Road  
P.O. Box 1139  
Rutherfordton NC 28139 -  
Mr. S. Bobo Tanner  
Chairman  
Ext: 121 122 123 . . .

Skein Dyers of America  
GA880525  
P.O. Box 784  
Dalton GA 30722 -  
Mr. W. Alderman  
Secretary/Treasurer  
(404)226-3826 ext:

Southern Apparel Company  
NC880023  
P.O. Box 29346  
Greensboro NC 27429 - 9346  
Mr. Richard H. McCaskill  
President  
(919)275-0756 ext:

Southern College of Technology  
GA890709  
1112 Clay Street  
Marietta GA 30060 -  
Mr. Howard Pettigrew  
ext:

Southern Technical Institute  
GA890708  
1112 Clay Street  
Marietta GA 30060 -  
Mr. Bill Cameron  
ext:

Sun Apparel, Inc.  
TX880038  
11201 Armour Drive  
El Paso TX 79935 -  
Mr. Larry Price  
Executive Vice President  
(915)598-1900 ext:

Swift Textiles, Inc.  
GA880146  
1410 6th Avenue  
P.O. Box 1400  
Columbus GA 31910 -  
Mr. John A. Bolano, III  
President & CEO  
(404)571-8444 ext:

Team American Vans  
GA890654  
1-N Main Street  
ILA GA 30647 -  
Mr. D. Jack Davis  
Owner  
ext:

MD880014  
P.O. Box 289  
Millersville MD 21108 -  
Mr. James T. Ferguson  
President  
(301)987-9111 ext:

WI880005  
416 McCutchan Hall  
Whitewater WI 53190 -  
Mr. Randall D. Olson  
Director  
(414)472-1600 ext:

Tennessee Apparel Corporation  
TN880068  
P.O. Box 670  
Tullahoma TN 37388 -  
Mr. Ted Helms  
Vice President  
(615)455-3468 ext:

Tennessee Apparel Corporation  
TN890114  
P.O. Box 670  
Tullahoma TN 37388 -  
Mr. Paul Blackwell  
ext:

Terry Manufacturing Company, Inc.  
AL880045  
924 South Street  
P.O. Box 648  
Roanoke AL 36274 -  
Mr. Roy Terry  
President  
(205)863-2171 ext:

Texfi Industries, Inc.  
NY880057  
1430 Broadway  
New York NY 10018 -  
Mr. Gerald Rubinfein  
VP Sales  
(212)930-7330 ext:

Texmac, Inc.  
NC880066  
3001 Stafford Drive  
P.O. Box 668128  
Charlotte NC 28266 -  
Mr. Ted Nishimura  
Senior Sales Manager  
(704)394-0314 ext:

The Sero Company, Inc.  
GA8900659  
510 9th Avenue East  
Cordele GA 31015 -  
Mr. Sammie Ballard  
Operations Manager  
(912)273-6188 ext:

Todd Corporation  
TN890083  
North Industrial Park  
Ridley TN 38063 -  
Mr. Richard Ring  
Engineering Manager  
ext:

Toddle Tyke Company  
GA880493  
440 Armour Place, N.E.  
Atlanta GA 30324 -  
Mr. Samuel S. Schools  
President  
(404)875-8953 ext:

Toombs County Manufacturing Co.  
GA880469  
Highway 292 West  
P.O. Box 657  
Lyons GA 30436 -  
Mr. M. W. Oxley  
President  
(912)526-8101 ext:

Toombs County Manufacturing Co.  
GA880591  
P.O. Box 657  
Lyons GA 30436 -  
Mr. Mike Holland  
Partner  
(912)526-8101 ext:

U.S. Air Force  
OH890013  
HSD/YAGC  
Area B, Bldg 55  
Wright Patterson AFB OH 45433 - 6503  
Captain Catherine M. McGinn  
Chief, Air Force Clothing Branch  
(513)255-4733 ext:

U.S. Army  
VA890057  
14050 Dawson Beach Road  
Woodbridge VA 22191 -  
Col. Rick Grube  
Project Manager  
ext:

University Extension

University of New Mexico

Mr. Frank Seibert  
Director SBDC  
(314)882-2394 ext:

Vanderbilt Shirt Company  
NC880049  
Bingham Road  
P.O. Box 851  
Asheville NC 28802 -  
Ms. Mia C. Waddoupe  
Vice President  
(704)255-8686 ext:

Vanity Fair Mills, Inc.  
AL880056  
624 South Alabama Ave.  
P.O. Box 111  
Monroeville AL 36462 -  
Mr. Bill Greenfield  
Manager, Industrial Engineering  
(205)575-3231 ext:

Veit, Incorporated  
GA880621  
2615 Mountain Industrial Blvd., Unit 11145  
Tucker GA 30084 -  
Mr. William Watkins  
Vice President/General Manager  
(404)938-2862 ext:

W.L. Corey & Associates  
MD890026  
100 Airport Rd. Bld. #2  
P.O. Box 729  
Elkton MD 21921 -  
Ms. Jean Norvell  
Product Specialist  
(301)392-3500 ext:

Watauga Apparel Corporation  
TN880058  
P.O. Box 5339 EKS  
Johnson City TN 37603 -  
Mr. Earl W. Smith  
President  
(615)928-3152 ext:

Wendell Textiles, Inc.  
MD880022  
8803 Kelso Drive  
Baltimore MD 21221 -  
Mr. Thomas Mulgrew  
Vice President  
(301)687-8500 ext:

West Point Peppercell  
GA890692  
4150 Boulder Ridge Dr.  
Atlanta GA 30336 -

Mr. James T. Ray  
Dir. Business Assistance & Res. Center  
ext:

Vanity Fair Mills  
AL880060  
624 S. Alabama Avenue  
P.O. Box 111  
Monroeville AL 36462 -  
Mr. Carl Langlois  
(205)575-3231 ext:

Varat Enterprises, Inc.  
SC880013  
P.O. Box 8793  
Greenville SC 29604 -  
Mr. Joshua Varat  
President  
(803)277-2693 ext:

Venture Uniforms, Inc.  
FL880018  
11145 Watts Street  
P.O. Box 41066  
Jacksonville FL 32204 -  
Mr. Frank Caldwell  
Plant Manager  
(904)354-1658 ext:

Warren Featherbone Company  
GA880494  
999 Chestnut Street S E  
P.O. Box 383  
Gainesville GA 30501 -  
Mr. Jeff Whalen  
Director of Merchandising  
(404)535-3000 ext:

Waterbury Companies, - Button Div.  
CT890012  
P.O. Box 1812  
Waterbury CT 06725 -  
Mr. Donald B. Petersen  
Sales and Marketing Manager  
ext:

Wesleyan, Inc.  
IL880037  
155 North Harbor Dr. Suite 1804  
Chicago IL 60601 -  
Mr. Wesley Schneider  
ext:

western Textile Products  
TN860070  
594 Linden Avenue  
Memphis TN 38126 -

Westex Inc.  
IL890041  
2845 W. 48th Pl.  
Chicago IL 60632 -  
Dr. W. F. Baitinger  
VP Technical  
ext:

Wool Bureau, Inc.  
NY880132  
225 Crossways Park Drive  
Woodbury NY 11797 - 6572  
Mr. R. Carl Freeman  
VP Product Dev. & Tech. Svc.  
ext:

William Carter Company  
GA880485  
P.O. Box 508  
Sandersville GA 31082 -  
Mr. Brab Young  
Plant Manager  
(912) 552-3936 ext:

Woolrich Inc.  
PA880080  
Mill Street  
Woolrich PA 17779 -  
Mr. Larry Little  
Vice President, Manufacturing  
(717) 769-6464 ext: